Results on main elasmobranch species from 2001 to 2020 Porcupine Bank (NE Atlantic) bottom trawl surveys

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Abstract

This working document presents the results of the most significant elasmobranch species caught on the Porcupine Spanish Groundfish Survey (SP-PORC-Q3) in 2020. Biomass, abundance, distribution and length frequency were analysed for *Galeus melastomus* (blackmouth catshark), *Deania calcea* (birdbeak dogfish), *Deania profundorum* (arrowhead dogfish), *Scymnodon ringens* (knifetooth dogfish), *Scyliorhinus canicula* (lesser spotted dogfish), *Etmopterus spinax* (velvet belly lantern shark), *Dalatias licha* (kitefin shark), *Hexanchus griseus* (bluntnose sixgill shark), *Dipturus nidarosiensis* (Norwegian skate), *Dipturus batis* (common skate), *Dipturus intermedius* (common skate), *Leucoraja circularis* (sandy ray) and *Leucoraja naevus* (cuckoo ray), *Squalus acanthias* (picked dogfish) and *Raja clavata* (thornback ray). In 2020 the biomass of *D. calcea, S. ringens, D. nidarosiensis*, *H. griseus and D. licha* increased, whereas it decreased for *G. melastomus*, *S. canicula, E. spinax* and *L. circularis*. Signs of recruitment were found for *S. ringens* and *E. spinax.* Only a few specimens of *S. acanthias, D. profundorum*, *R. clavata, D. batis, L. naevus and D. intermedius* were captured. The species *R. montagui*, with regular presence in the historical series, was not found in 2020 survey.

Introduction

The Spanish bottom trawl survey on the Porcupine Bank (ICES Divisions 7c and 7k) has been carried out annually in the third-quarter (September) since 2001 to provide data and information for the assessment of the commercial fish species in the area (ICES, 2017).

The aim of this working document is to update the results (biomass and abundance indices, length frequency and geographic distributions) of the most common elasmobranch species on Porcupine bottom trawl surveys, after the results presented previously (Ruiz-Pico *et al.* 2014; Fernández-Zapico *et al*. 2015; Ruiz-Pico *et al.* 2016; Fernández-Zapico *et al*. 2017; Ruiz-Pico *et al.* 2018, 2019, 2020). The species analysed were: *Galeus melastomus* (blackmouth catshark), *Deania calcea* (birdbeak dogfish), *Deania profundorum* (arrowhead dogfish), *Scymnodon ringens* (knifetooth dogfish), *Etmopterus spinax* (velvet belly lantern shark), *Scyliorhinus canicula* (lesser spotted dogfish), *Dalatias licha* (kitefin shark), *Hexanchus griseus* (bluntnose sixgill shark), *Leucoraja circularis* (sandy ray), *Leucoraja naevus* (cuckoo ray), *Dipturus nidarosiensis* (Norwegian skate), *Dipturus batis* and *Dipturus intermedius* (common skate), *Squalus acanthias* (picked dogfish) and *Raja clavata* (thornback ray).

Material and methods

The Spanish Ground Fish Survey on the Porcupine Bank (SP-PORC-Q3) has been carried out annually since 2001 onboard the R/V *Vizconde de Eza*, a stern trawler of 53 m and 1800 Kw. The area covered extends from longitude 12° W to 15° W and from latitude 51° N to 54° N (Figure 1), following the standard methodology for the IBTS North Eastern Atlantic surveys (ICES, 2017). The sampling design was random stratified to the area (Velasco and Serrano, 2003) with two geographical sectors (Northern and Southern) and three depth strata (< 300 m, 300-450 m and 450-800 m) (Figure 2). Hauls allocation is proportional to the strata area following a buffered random sampling procedure (as proposed by Kingsley et al., 2004) to avoid the selection of adjacent 5×5 nm rectangles. More details on the survey design and methodology are presented in ICES (2017).

The tow duration is 20 min since 2016, but the results were extrapolated to 30 min of trawling time to keep up the time series.

Biomass, geographical distribution and length compositions were analysed, and the mean stratified biomass of the most abundant species of the last two years was compared with the mean of the previous five years.

Results and discussion

Despite the problems created by the pandemic and the COVID-19 disruption, the Porcupine Groundfish Survey was carried out without major problems, apart from an initial 9-day delay that did not affect the overall survey duration.

In 2020, 81 valid standard hauls and 10 additional hauls were carried out. Among the additional hauls, three of them have been carried out into the standard stratification, to improve coverage in the gaps left by random sampling and seven of them, between 839 and 1425 m, to explore the continuity of the fish community in Porcupine Seabight (Figure 2).

The total stratified catch per haul increased significantly in 2020 compared to the previous year, becoming the second highest catch in the historical series below the year 2015 (Figure 3). Fish represented 96% of the total stratified catch and the elasmobranchs were the 4% of that total fish catch, with the following percentages per species: *Galeus melastomus* (60%), *Scymnodon ringens* (9.4%), *Deania calcea* (12%), *Scyliorhinus canicula* (4.9%), *Etmopterus spinax* (2.9%), *Hexanchus griseus* (2.3%), *Dalatias licha* (0.9%), *Squalus acanthias* (0.2%) and *D.profundorum* (0.04%). The skate and rays species were: *Leucoraja circularis* (1.5%), *Leucoraja naevus* (0.5%), *Raja clavata* (0.04%), *Dipturus nidarosiensis* (4.3%), *Dipturus batis* (0.4%) and *Dipturus intermedius* (0.7%).

In 2020 the biomass of *D. calcea, S. ringens, D. nidarosiensis*, *H. griseus and D. licha* increased, whereas it decreased for *G. melastomus*, *S. canicula, E. spinax* and *L. circularis*. Regarding recruitment, small specimens remained low in general, but a slight increase was found for *S. ringens* and *E. spinax.* Only a few specimens of *S. acanthias,* *D. profundorum*, *R. clavata, D. batis, L. naevus and D. intermedius* were found. On the contrary, the species *R.montagui*, with regular presence in the historical series, was not captured in this last survey. In addition, the species *Apristurus laurussonii, Galeus murinus, Centroscymnus coelolepis, Centroscymnus crepidater and Rajella fyllae* were found in the deep hauls of the Porcupine Seabight, between 839 and 1425 m.

***Galeus melastomus* (blackmouth catshark)**

In 2020, both the biomass and the abundance of *G. melastomus* almost halved compared to the previous year, both values falling within the average levels in the first part of the historical series between 2005-2011 (Figure 4). Accordingly, the comparative of the biomass value in the last two years with respect to the previous five also drops significantly (Figure 5).

Similarly to previous years, the species was mainly distributed in the southern deepest area, but with fewer spots of biomass in the northeast (Figure 6).

The length distribution ranged from 14 cm to 77 cm in this last survey and the three usual modes of the historical series were shown (24 cm, 47 cm and 66 cm). However, there is a slight increase in the abundance of the medium sizes, as well as a decrease in the abundance of the smallest individuals and, also and more markedly, in the larger ones (Figure 7).

***Deania calcea* (birdbeak dogfish) and *Deania profundorum* (arrowhead dogfish)**

Although *D. profundorum* was rather scarcer than *D. calcea* in the area, it has been found every survey since *D. profundorum* was first identified in 2012.

The biomass and abundance of *Deania spp.* (mainly *D. calcea*) have followed a downward trend since 2016. However, this trend was broken in this last survey and it increased slightly in both biomass and abundance (Figure 8 and Figure 9). The biomass and abundance of *D. profundorum* decreased slightly after the increased of the previous year (Figure 10).

The specimens of *D. calcea* were mainly found in western deepest strata, as usual, as well as some spots of biomass in the southern deepest strata in this last survey (Figure 11). They ranged from 73 cm to 126 cm, with two modes, in 86-88 cm and 108 cm, consistent with the mean of the historical series (Figure 12). Only three hauls have had presence of *D. profundorum*, between 500 and 600 m, with individuals from 29 to 69 cm.

***Scymnodon ringens* (knifetooth dogfish)**

Both biomass and abundance of *S. ringens* increased in 2020 compared to the previous year, although more markedly in abundance, more than doubled the value of the previous year. The biomass index of the last two years increased slightly compared to the previous five years (Figure 13 and Figure 14).

As usual, *S. ringens* was found in the deepest strata, in the southern area (Figure 15).

The length distribution ranged from 34 cm to 110 cm in this last survey and three modes can be distinguished (37- 40 cm, 72 cm and 106 cm). A considerable increase in the abundance of the smallest individuals can be seen in comparison with the mean value of the historical series (Figure 16).

***Scyliorhinus canicula* (lesser spotted dogfish)**

The biomass and abundance of *S. canicula* continued decreasing in this last survey (Figure 17) and the mean biomass of the last two years was lower than in the previous five years (Figure 18).

S. canicula was distributed around the bank itself and on the Irish shelf, as usual, but with fewer and smaller spots of biomass (Figure 19).

The length distribution ranged from 33 cm to 85 cm in this last survey, with a mode around 62 cm. However, the small individuals, between 15 and 30 cm that were noted in 2019 survey did not appear in 2020 (Figure 20).

***Etmopterus spinax* (velvet belly)**

Although the abundance of *E. spinax* increased further in 2020, the biomass decreased slightly compared to the previous year (Figure 21) and the mean stratified biomass in the last two years remained also lower than in the previous five years (Figure 22).

E. spinax was distributed in the southeast area, as usual, and there was also another conspicuous but smaller spot in the deepest southern area, as well as in the northern area, around the bank (Figure 23).

The length distribution of *E. spinax* showed signs of recruitment in this last survey, showing an increment of small specimens (11- 19 cm) and a conspicuous mode in 22-23 cm compared to the mean values of the historical series (Figure 24).

***Hexanchus griseus* (bluntnose sixgill shark)**

The abundance of this scarce shark has slightly decreased in 2020 and, although the biomass has continued to rise since last year (Figure 25), the mean biomass of the last two years remained well below the value of the previous five years mainly due to the peak in 2014 (Figure 26).

The geographical distribution as usual did not show a clear pattern, but in this last survey all of the specimens were found south to the bank, mostly in the deepest strata (Figure 27).

A total of eight hauls showed presence of *Hexanchus griseus*, between 191 and 594 m deep. The length distribution has a smaller range compared to the historical catches, without showing the smallest or largest individuals, and ranged from 74 to 160 cm in 2020 (Figure 28).

***Dalatias licha* (kitefin shark)**

The biomass index of *D. licha* increased slightly in this last survey and the abundance decreased, though very little (Figure 29). The mean biomass of the last two years remained low compared to the value of the previous five years, due to the 2014 peak (Figure 30). A total of 8 hauls showed presence of this species, between 469 and 834 m deep, where individuals with sizes from 34 to 108 cm were found, mainly in the deepest strata in the south and west of the study area (Figure 31 and Figure 32).

***Squalus acanthias* (picked dogfish)**

In 2020, the biomass and abundance of this scarce elasmobranch decreased slightly, maintaining the average values of the time series (Figure 33). Only one 110 cm specimen was found in one haul at 230 m deep southwest of the bank (Figure 34).

***Leucoraja naevus* (cuckoo ray) and *Leucoraja circularis* (sandy ray)**

L. naevus has been slightly scarcer than *L. circularis* in the area, although the abundance of the former has been higher in the last two years. In 2020, both biomass and abundance fell for the two species, being among the average values of the time series for *L. circularis* but among the low values of the series for *L. naevus* (Figure 35).

In 2020, as usual, specimens of *L. naevus* were found in the shallower stratum around the bank itself, whereas *L. circularis* was caught in a deeper stratum to the southwest and north of the bank (Figure 36 and Figure 37).

In this last survey, specimens of *L. naevus* ranged from 28 to 61 cm, showing a mode around 57 cm, according to the mean values of the last ten years, and a scarce presence of individuals below 40 cm (Figure 38).

Although *L. circularis* usually presents a wider range of sizes, in 2020 it ranged from 26 to 109 cm, but most of the specimens were between 36 and 63, showing a remarkable decrease in individuals larger than 63 cm (Figure 39).

***Dipturus* spp. (common skate)**

Dipturus nidarosiensis, *Dipturus cf. flossada* and *Dipturus intermedius* were comparatively analysed since 2011, unlike previous reports, when *D. batis* was split into *D. cf. flossada* and *D. cf. intermedia* (Iglésias et al., 2009). Recently, *Dipturus cf. flossada* has been accepted as *D. batis, whereas D. cf. intermedia* has kept its original name as *D. intermedius* (Last et al., 2016). The three rays together as *Dipturus* spp. were also analysed.

The biomass of *Dipturus* spp. decreased in 2020 and even more strongly its abundance, reducing by more than half compared to the previous year (Figure 40). The mean biomass index of the last two years remained lower than the previous five years (Figure 41). Specifically, both the biomass and the abundance of *D. batis* fell sharply with respect to the previous year, returning to the lowest values of the historical series. However, *D. nidarosiensis* slightly increased both biomass and abundance whereas *D. intermedius* decreased in biomass but increased in abundance, both species keeping the average values of the historical series (Figure 42).

A total of eight hauls, between 457 m and 1025 m deep, showed presence of the species *D. nidarosiensis*, in the deeper stratum to the south and east of the study area. However, as usual, the other two *Dipturus* were found shallower, specifically, the species *D. batis* was found in four hauls, between 282 m and 409 m deep, around the bank, whereas *D. intermedius* was found in six hauls, south of the bank and also in the deeper stratum at the southeast, between 191 m and 1025 m deep (Figure 43, Figure 44 and Figure 45).

In 2020, the specimens of *D. nidarosiensis* ranged from 26 cm to 188 cm, although no sizes were found between 26 cm and 155 cm (Figure 46). However, the specimens of *D. batis* (from 28 to 97 cm) and *D. intermedius* (from 24 to 115 cm) were smaller, as usual. Furthermore, the largest individuals of the last 10 years were not found (Figure 47 and Figure 48).

***Raja clavata* (thornback ray) and *Raja montagui* (spotted ray)**

One 56 cm specimen of *R. clavata* was found in the northeastern area of the Irish shelf, as in the previous year (Figure 49 and Figure 50). In contrast, the species *R. montagui* was not captured in 2020. The shallow habits of these two rays might explain the scarcity in the study area.

Acknowledgements

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of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy.

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Figures

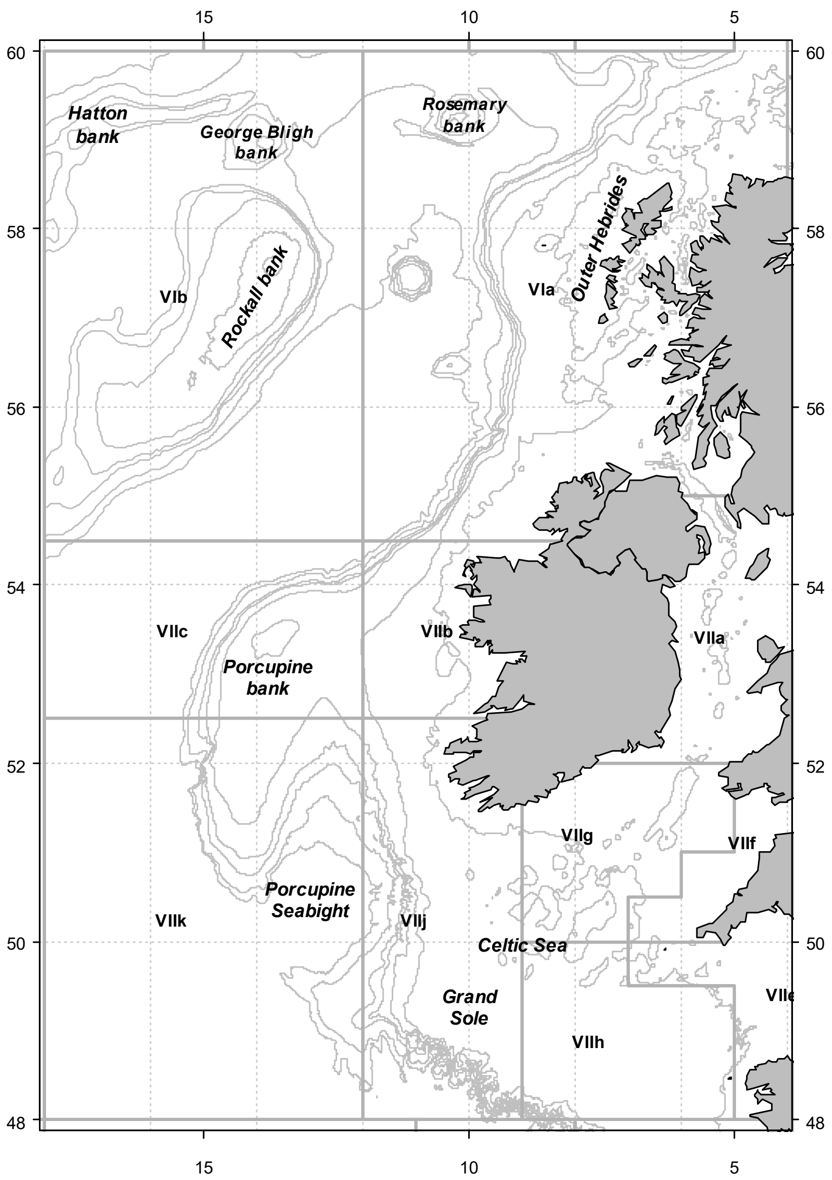

Figure 1. North eastern Atlantic showing the Porcupine bank, Porcupine Seabight, and ICES divisions

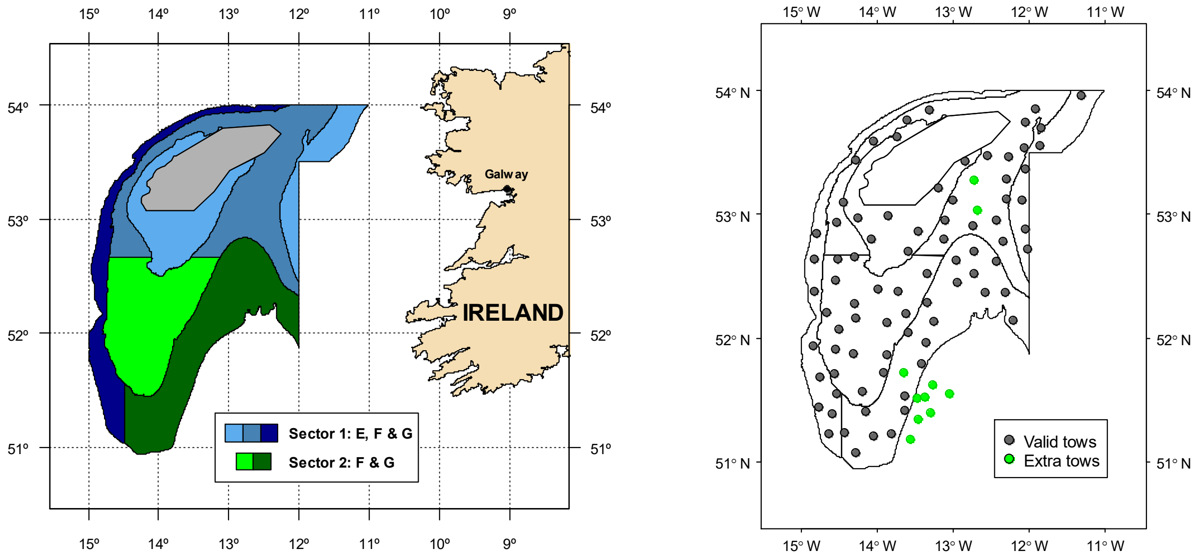

Figure 2. Left: Stratification design used in Porcupine surveys from 2003, previous data were re-stratified. Depth strata are: E) shallower than 300 m, F) 301- 450 m and G) 451-800 m. Grey area in the middle of Porcupine bank corresponds to a large non-trawlable area, not considered for area measurements and stratification. Right: hauls performed in 2020

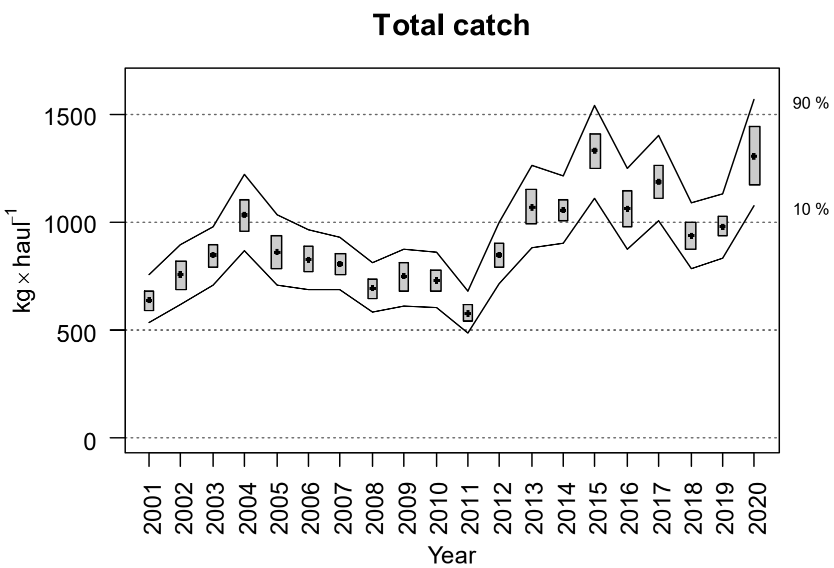

Figure 3.- Evolution of the total stratified catch in Porcupine surveys (2001-2020)

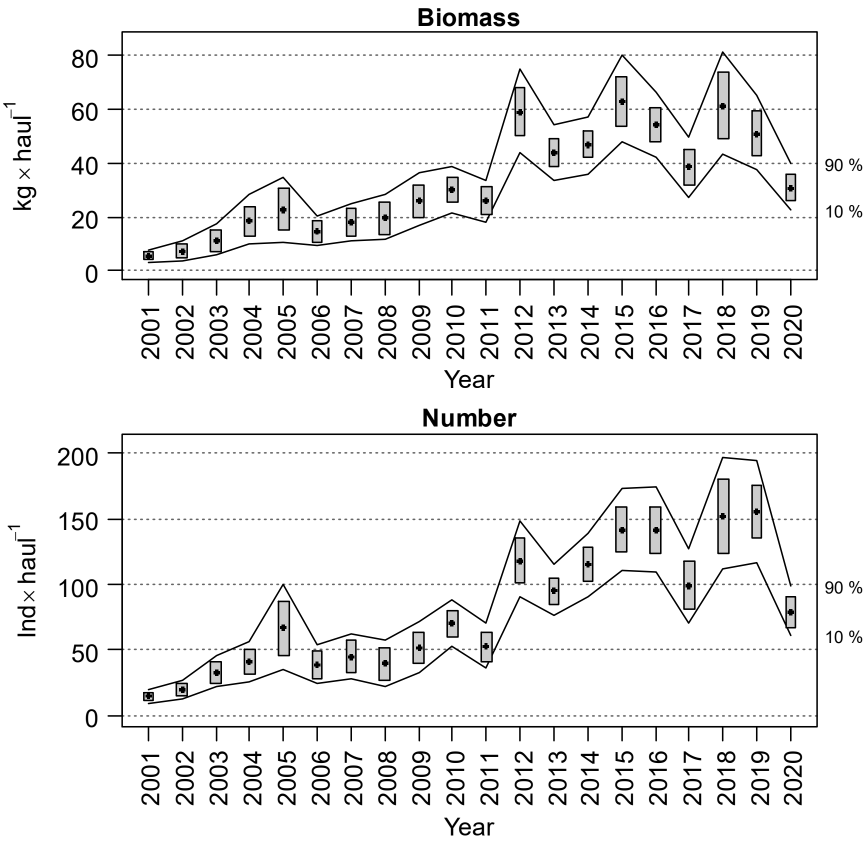

Figure 4.- Evolution of *Galeus melastomus* biomass and abundance indices in Porcupine surveys (2001-2020). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

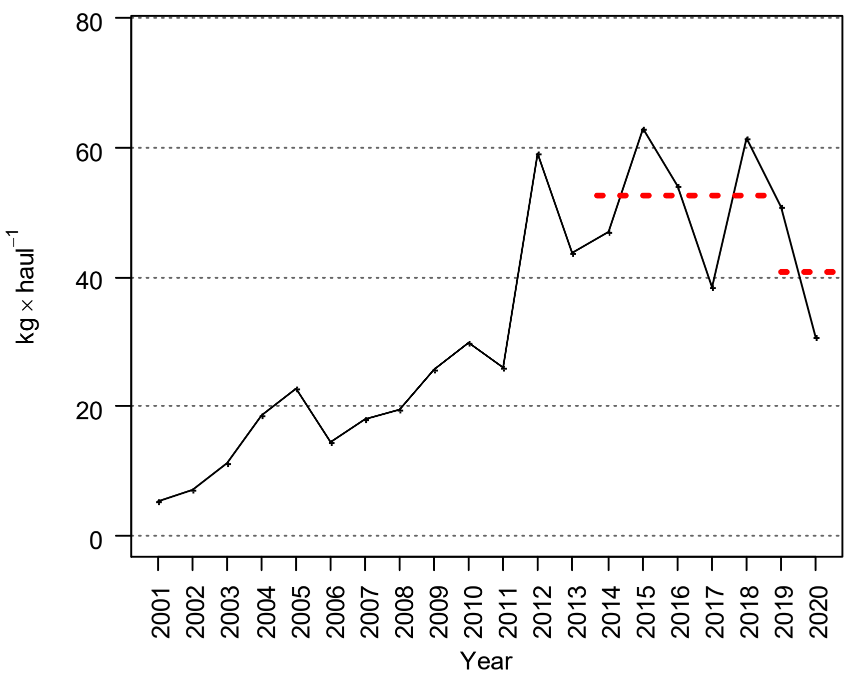

Figure 5. Evolution of *Galeus melastomus* biomass index in Porcupine surveys (2001-2020). Dotted lines compare mean stratified biomass in the last two years with the five previous years

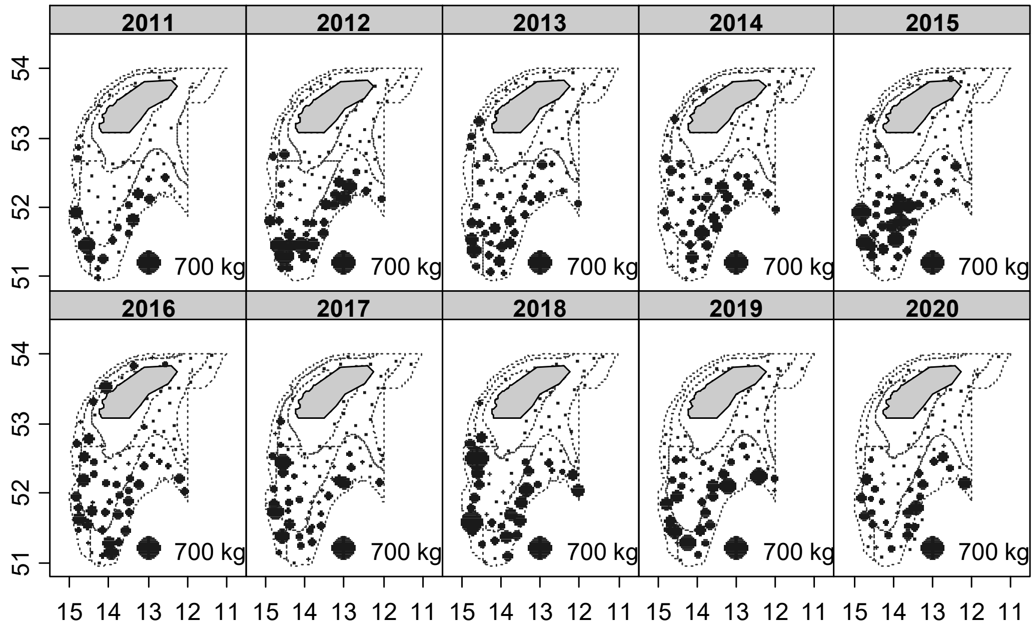

Figure 6.- Geographic distribution of *Galeus melastomus* catches (kg·haul^{-1}) in Porcupine surveys (2011-2020)

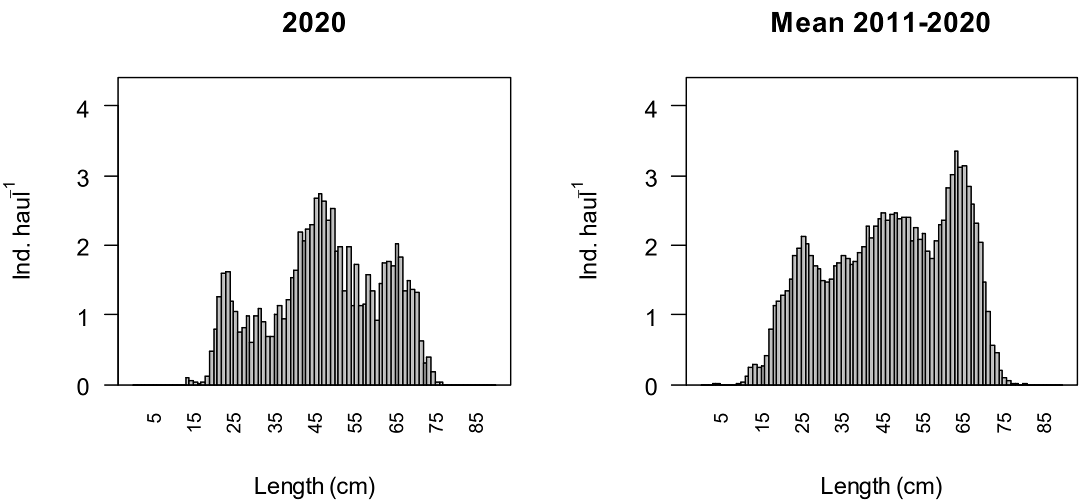

Figure 7. Stratified length distributions of *Galeus melastomus* in the last Porcupine survey, and mean values in Porcupine surveys (2011-2020)

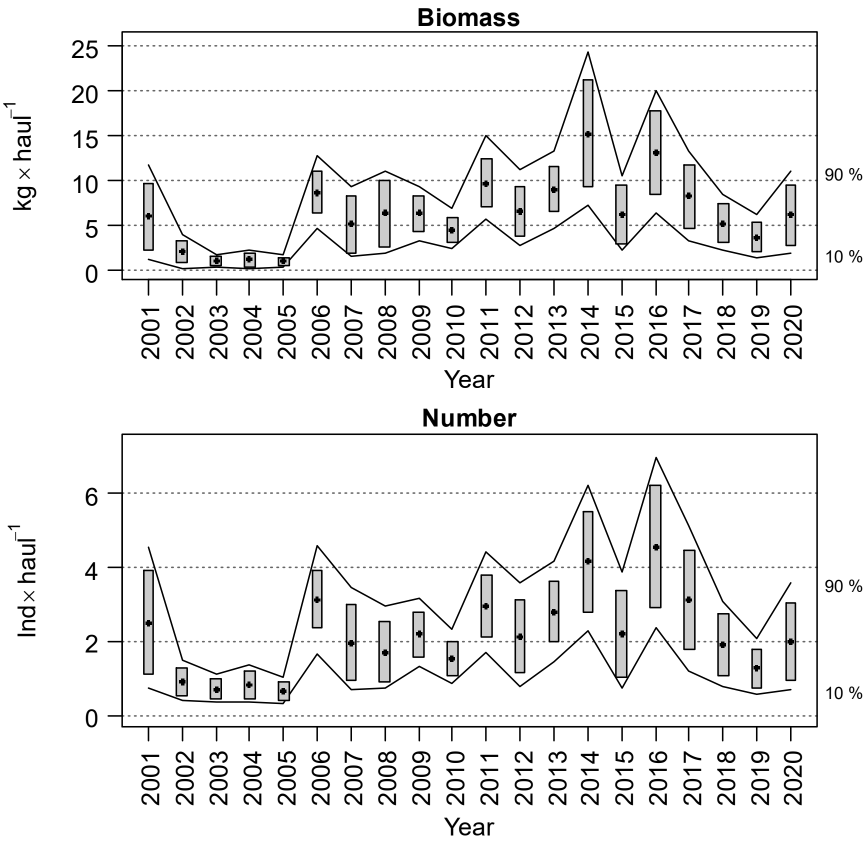

Figure 8. Evolution of *Deania* spp. (mainly *D. calcea)* biomass and abundance indices in Porcupine surveys (2001-2020). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations =1000)

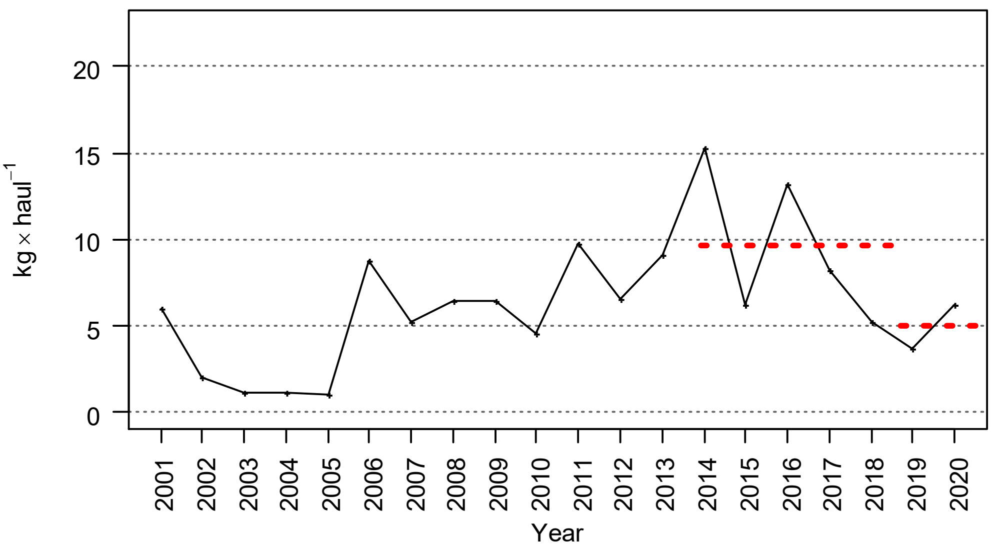

Figure 9.- Evolution in *Deania* spp. (mainly *D. calcea)* biomass index in Porcupine surveys (2001-2020). Dotted lines compare mean stratified biomass in the last two years with the five previous years

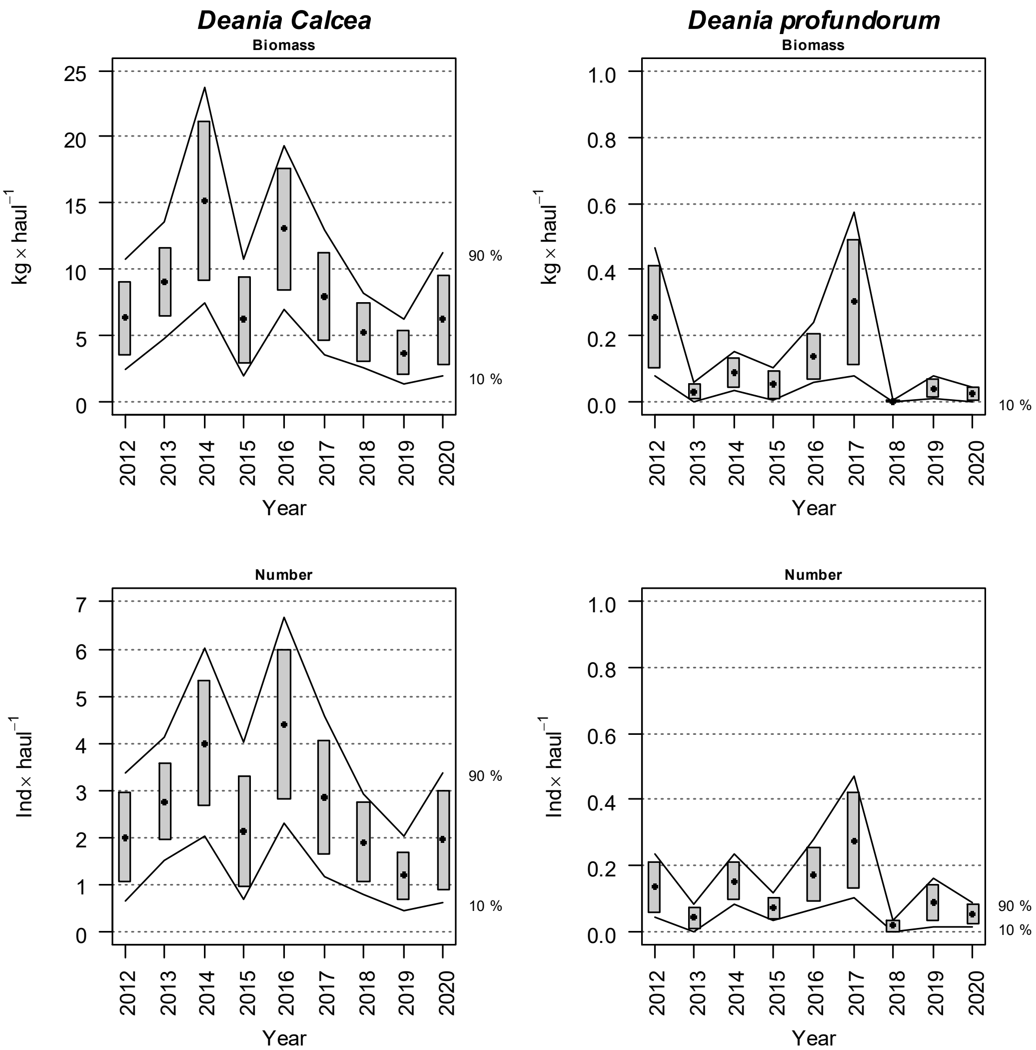

Figure 10.- Evolution of *Deania calcea* and *Deania profundorum* biomass and abundance indices from 2012 and 2020 Porcupine surveys. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations =1000)

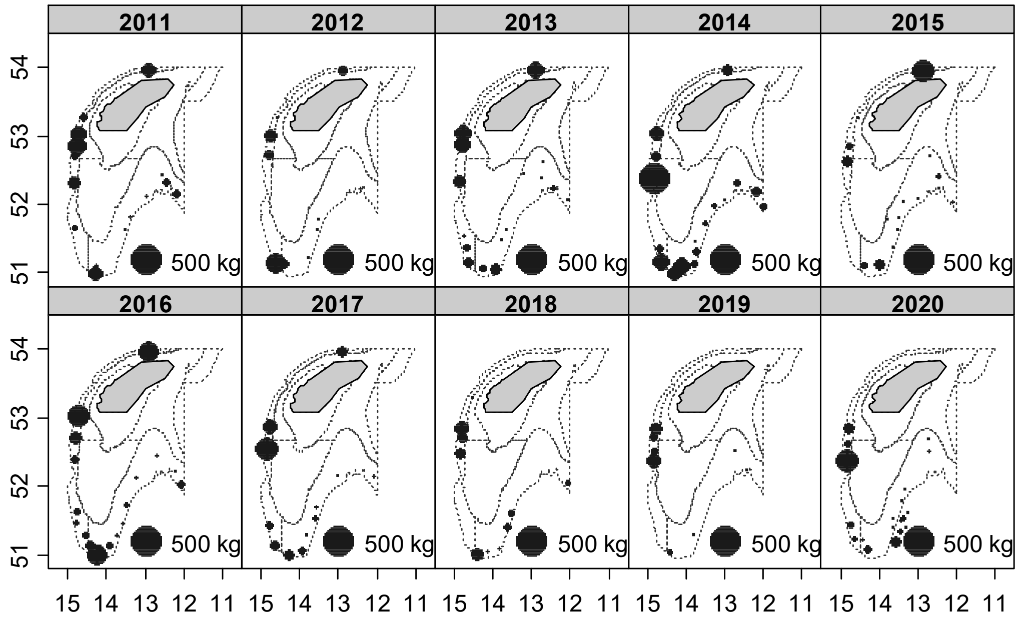

Figure 11.- Geographic distribution of *Deania* spp. (mainly *D. calcea*) catches (kg·haul^{-1}) in Porcupine surveys (2011-2020)

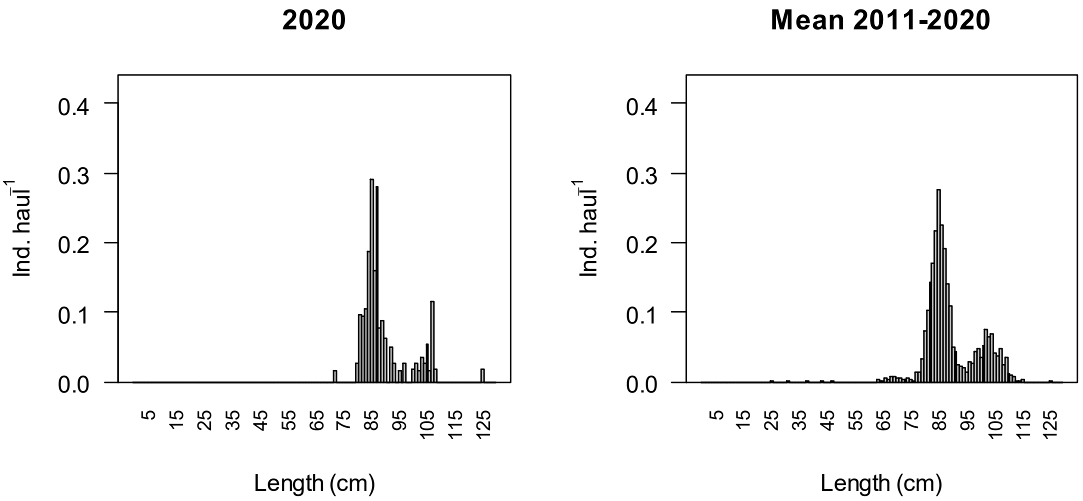

Figure 12. Stratified length distribution of *Deania calcea* in the last Porcupine survey, and mean values in Porcupine surveys (2011-2020)

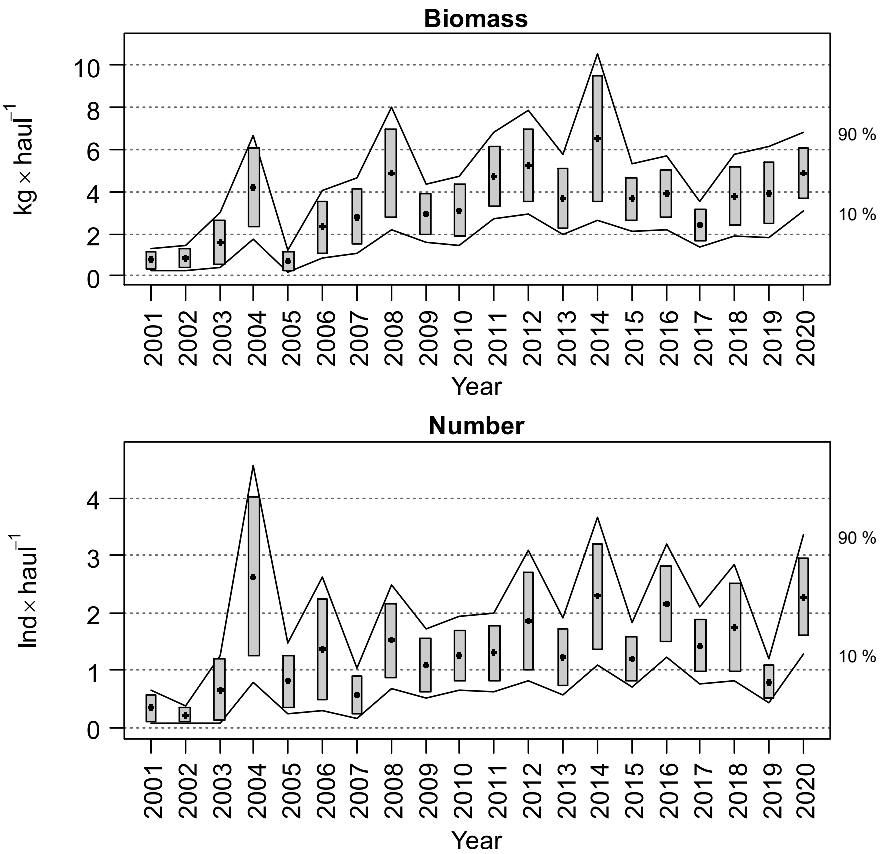

Figure 13. Evolution of *Scymnodom ringens* biomass and abundance indices in Porcupine surveys (2001-2020). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

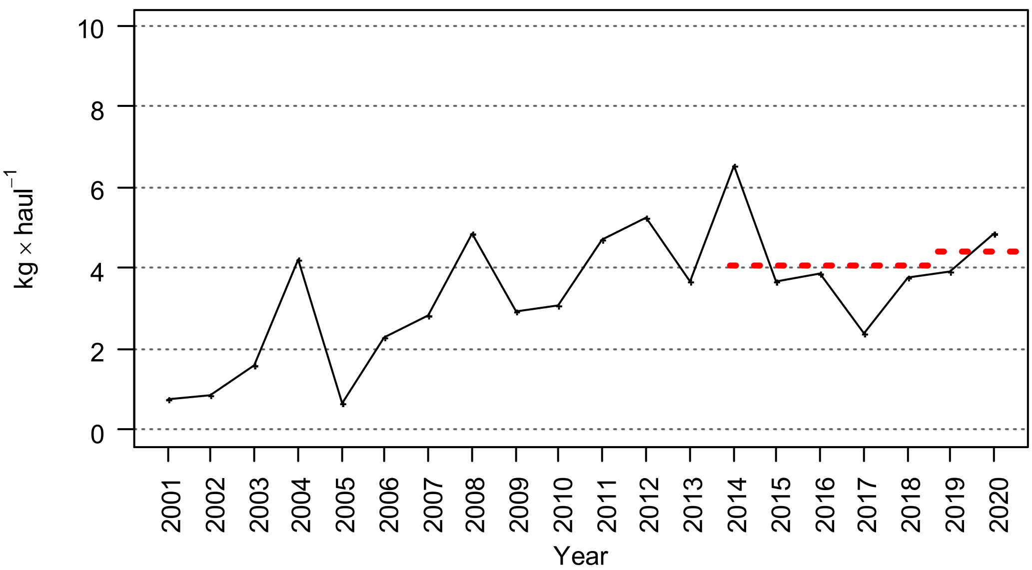

Figure 14. Evolution in *Scymnodom ringens* biomass index in Porcupine surveys (2001-2020). Dotted lines compare mean stratified biomass in the last two years with the five previous years

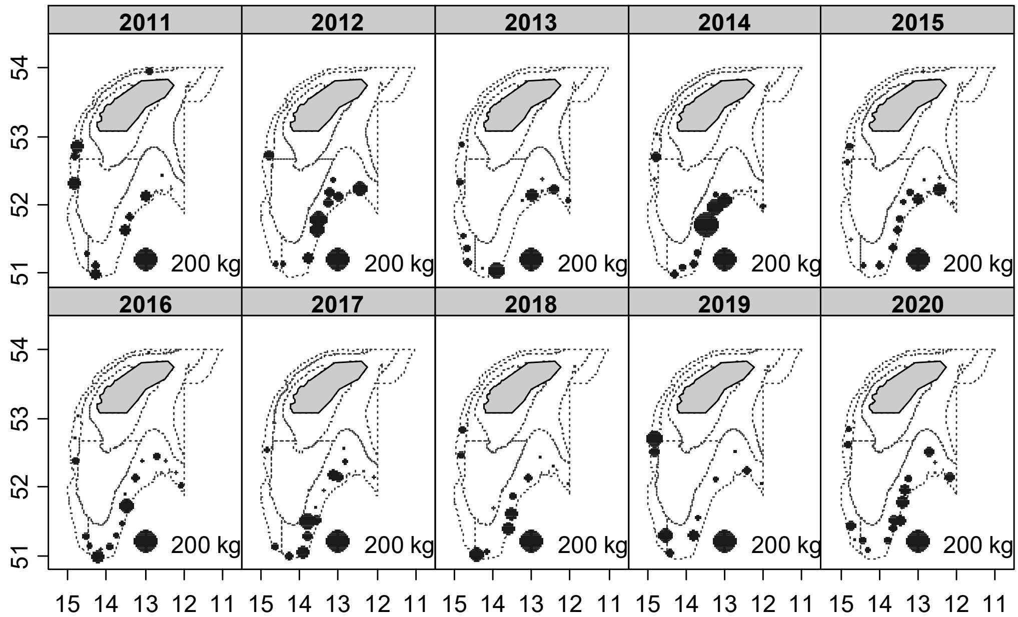

Figure 15. Geographic distribution of *Scymnodon ringens* catches (kg·haul^{-1}) in Porcupine surveys (2011-2020)

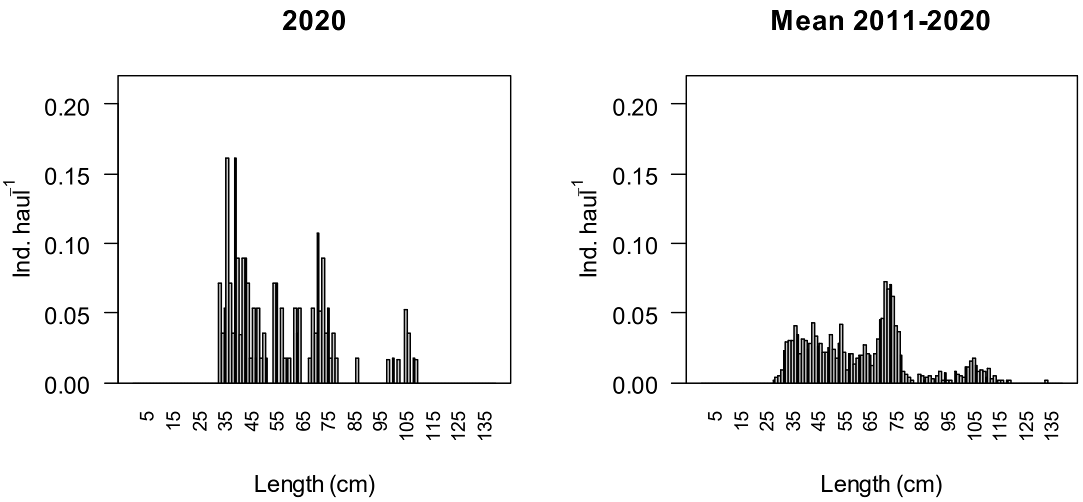

Figure 16. Stratified length distributions of *Scymnodon ringens* in the last Porcupine survey, and mean values in Porcupine surveys (2011-2020)

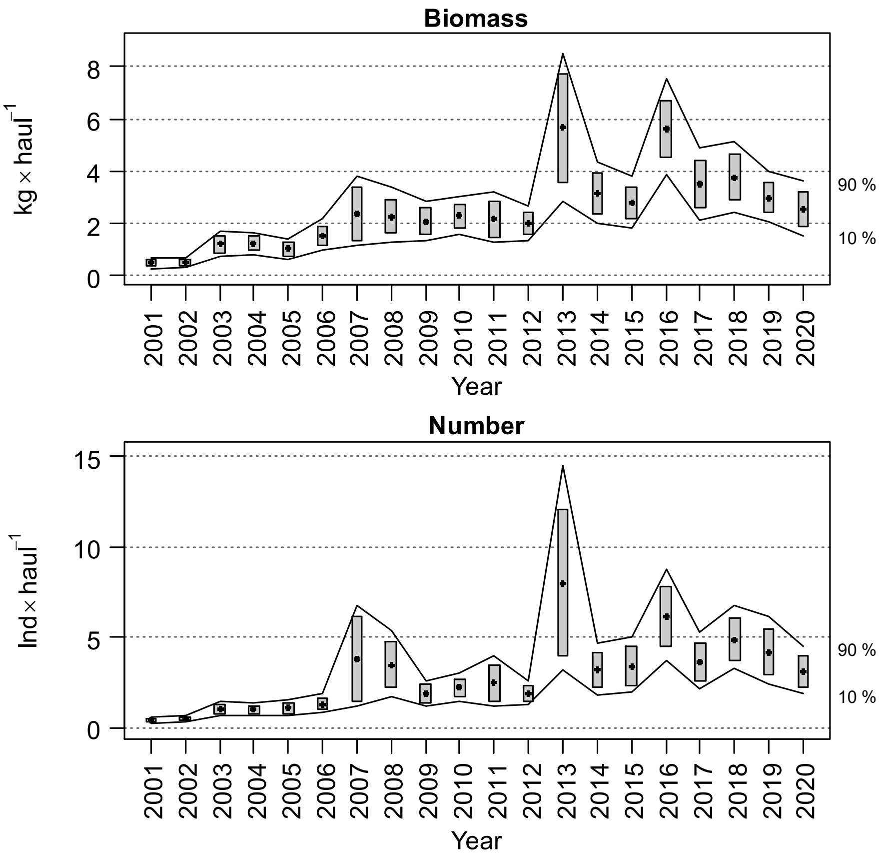

Figure 17. Evolution of *Scyliorhinus canicula* biomass and abundance indices in Porcupine surveys (2001-2020). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

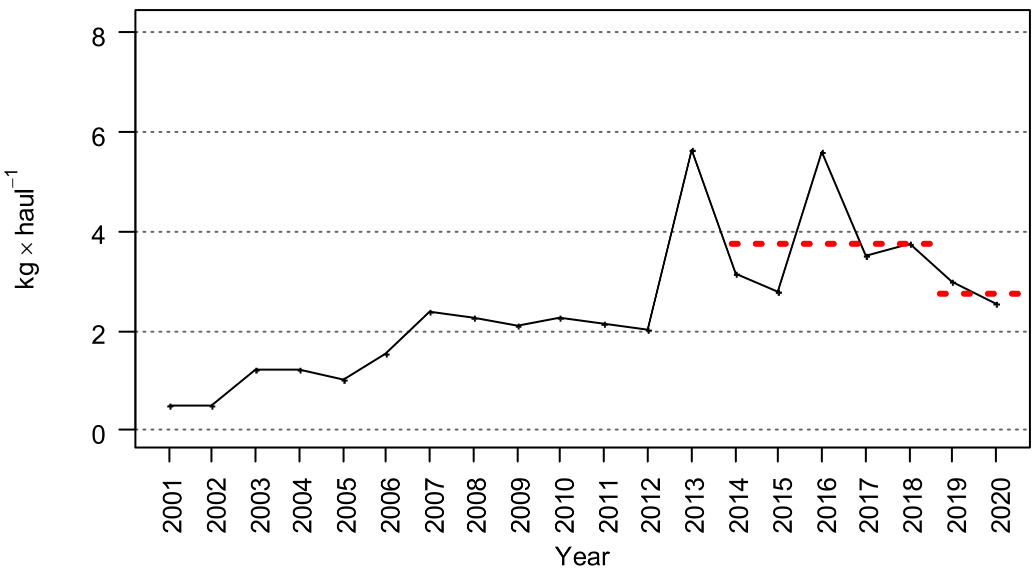

Figure 18. Evolution in *Scyliorhinus canicula* biomass index in Porcupine surveys (2001-2020). Dotted lines compare mean stratified biomass in the last two years with the five previous years

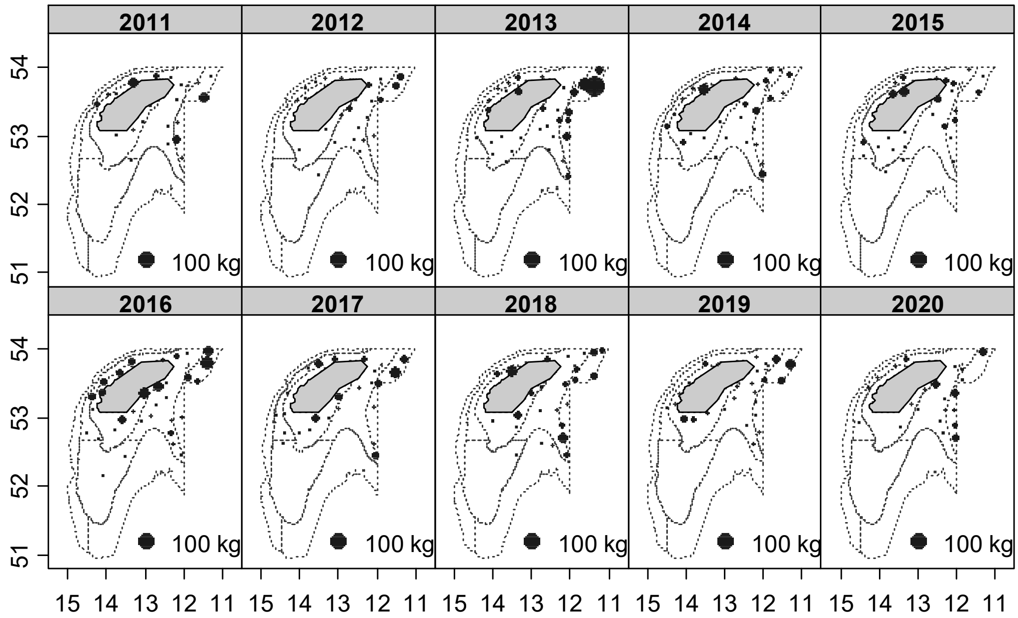

Figure 19. Geographic distribution of *Scyliorhinus canicula* catches (kg·haul^{-1}) in Porcupine surveys (2011-2020)

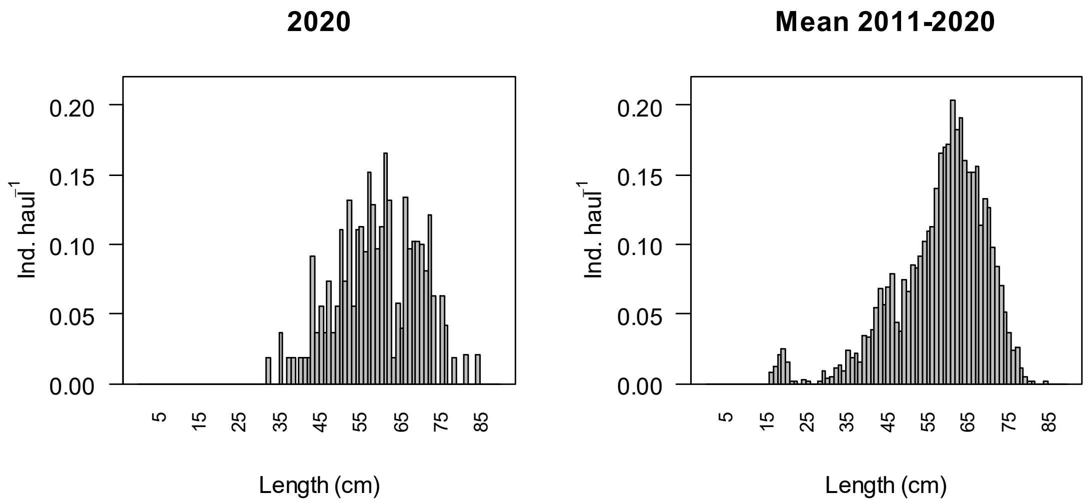

Figure 20. Stratified length distribution of *Scyliorhinus canicula* in the last Porcupine survey, and mean values in Porcupine surveys (2011-2020)

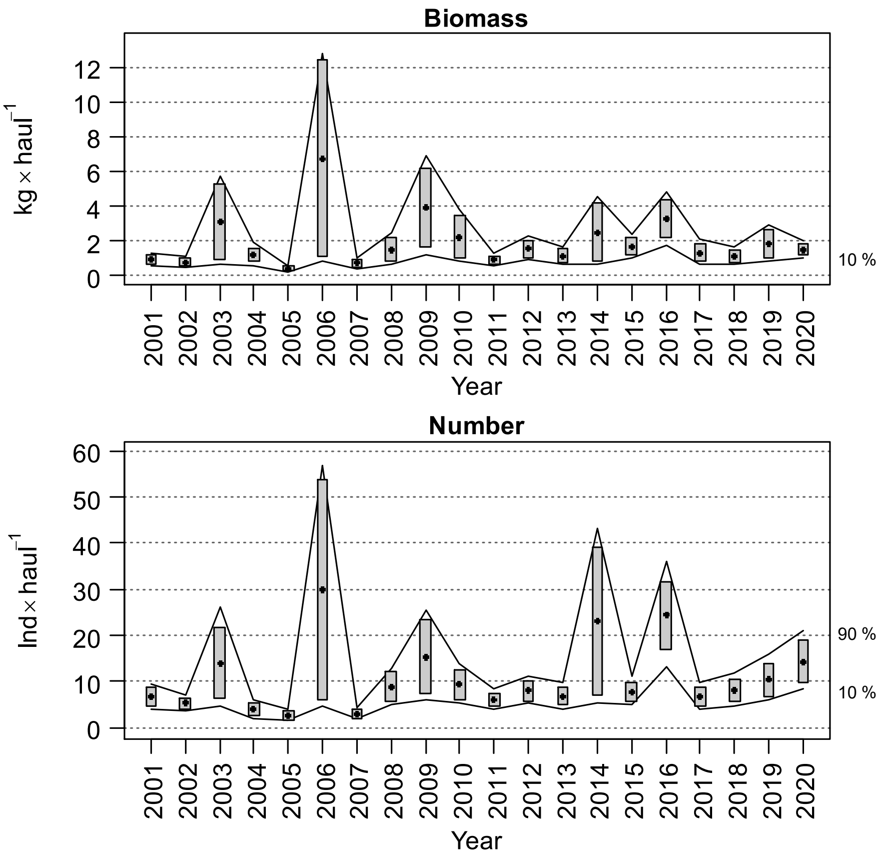

Figure 21. Evolution of *Etmopterus spinax* biomass and abundance indices in Porcupine surveys (2001-2020). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

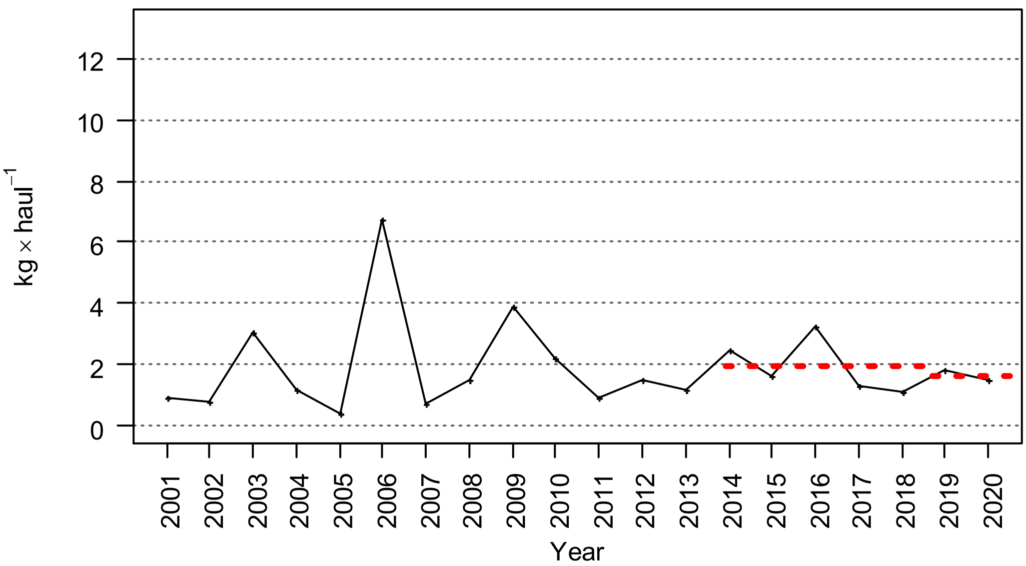

Figure 22. Evolution in *Etmopterus spinax* biomass index in Porcupine surveys (2001-2020). Dotted lines compare mean stratified biomass in the last two years with the five previous years

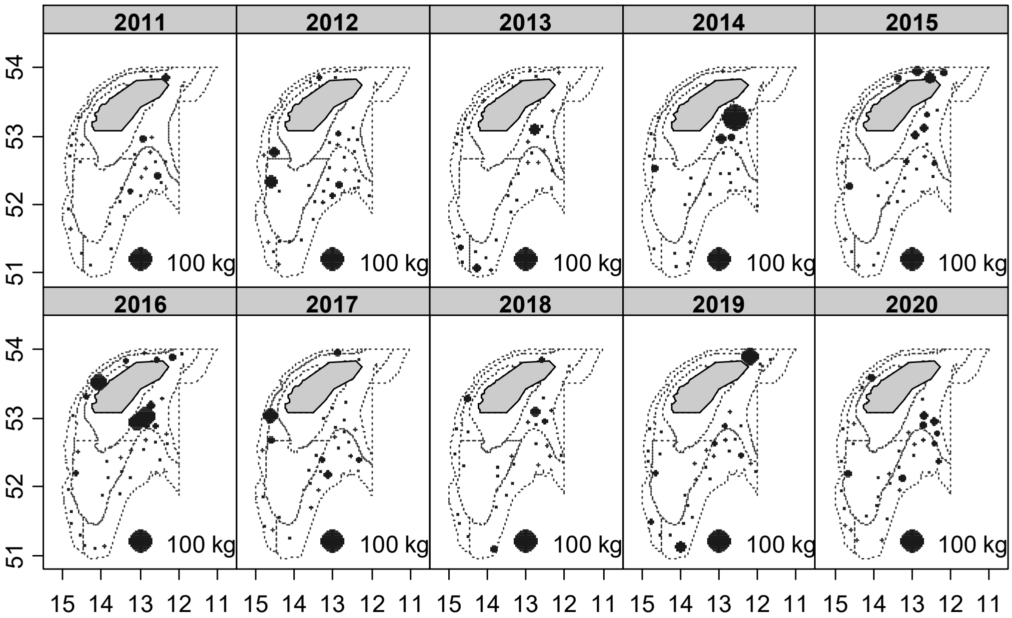

Figure 23. Geographic distribution of *Etmopterus spinax* catches (kg·haul^{-1}) in Porcupine surveys (2011-2020)

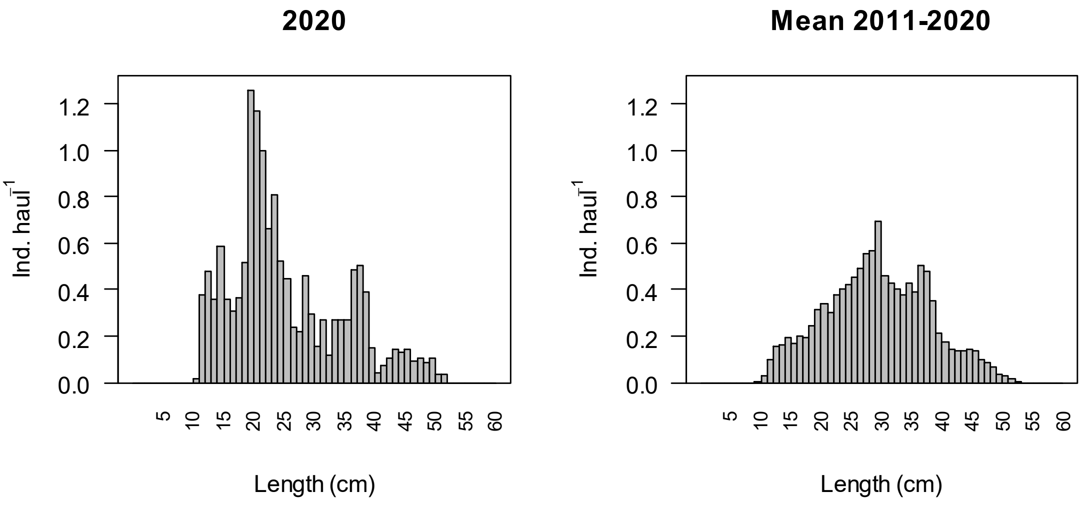

Figure 24. Stratified length distribution of *Etmopterus spinax* in the last Porcupine survey, and mean values in Porcupine surveys (2011-2020)

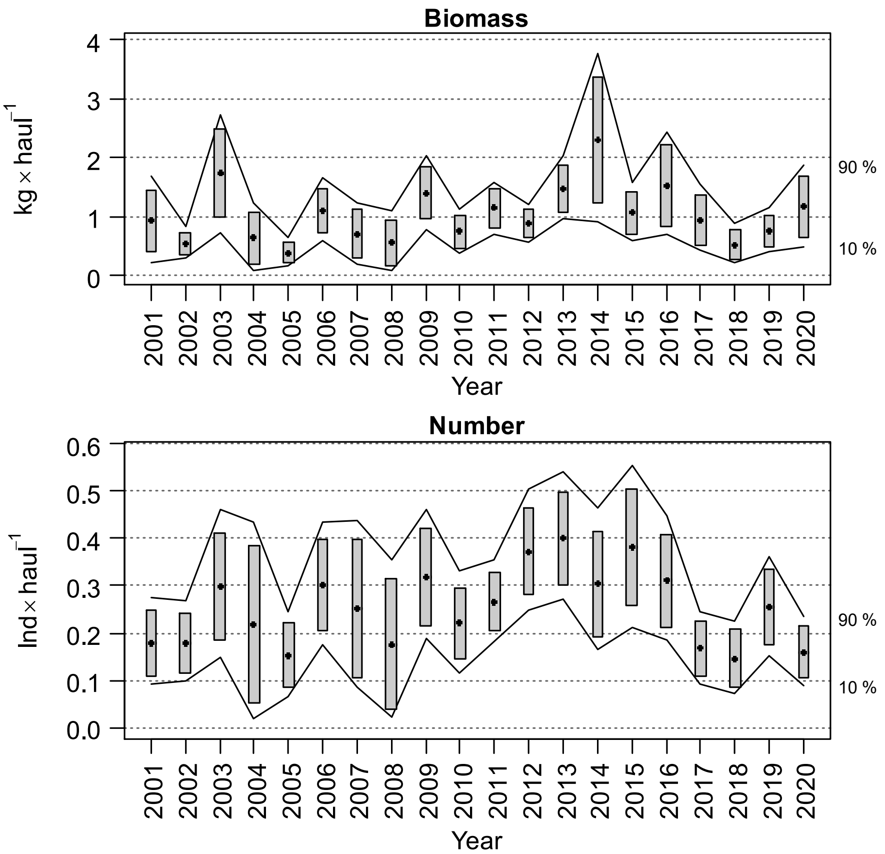

Figure 25. Evolution of *Hexanchus griseus* biomass and abundance indices in Porcupine surveys (2001-2020). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

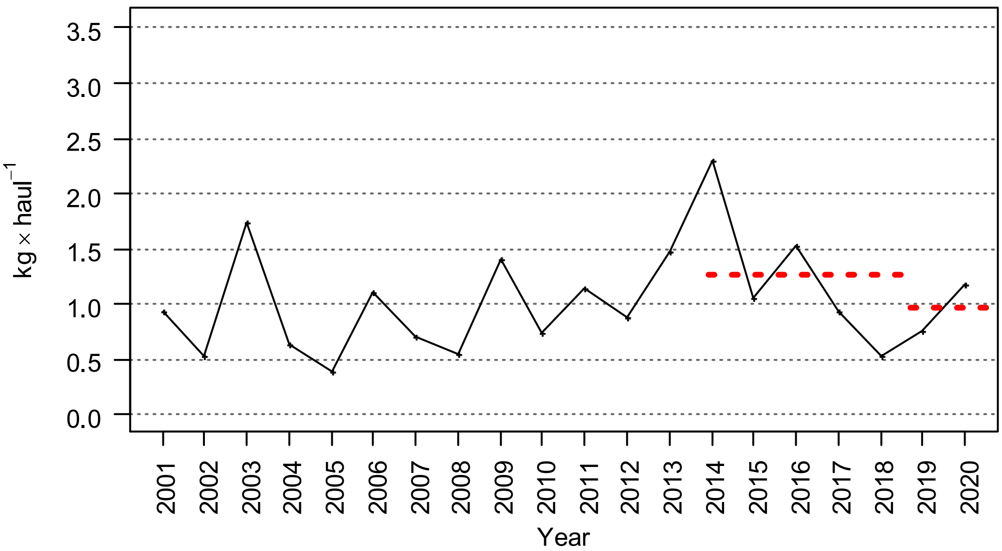

Figure 26. Evolution in *Hexanchus griseus* biomass index in Porcupine surveys (2001-2020). Dotted lines compare mean stratified biomass in the last two years with the five previous years

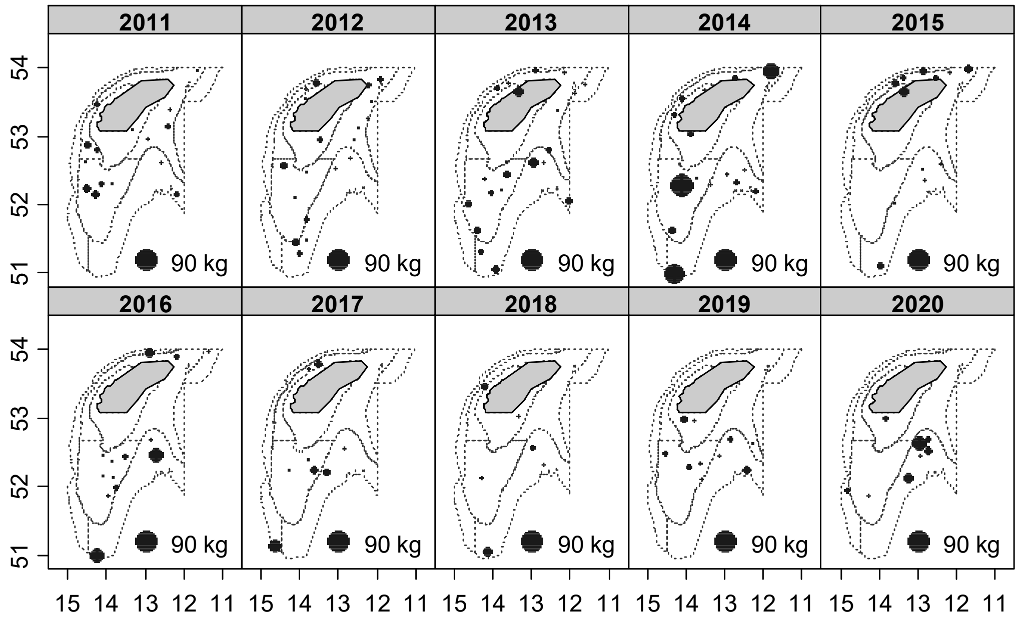

Figure 27. Geographic distribution of *Hexanchus griseus* catches (kg×30 min haul^{-1}) in Porcupine surveys (2011-2020)

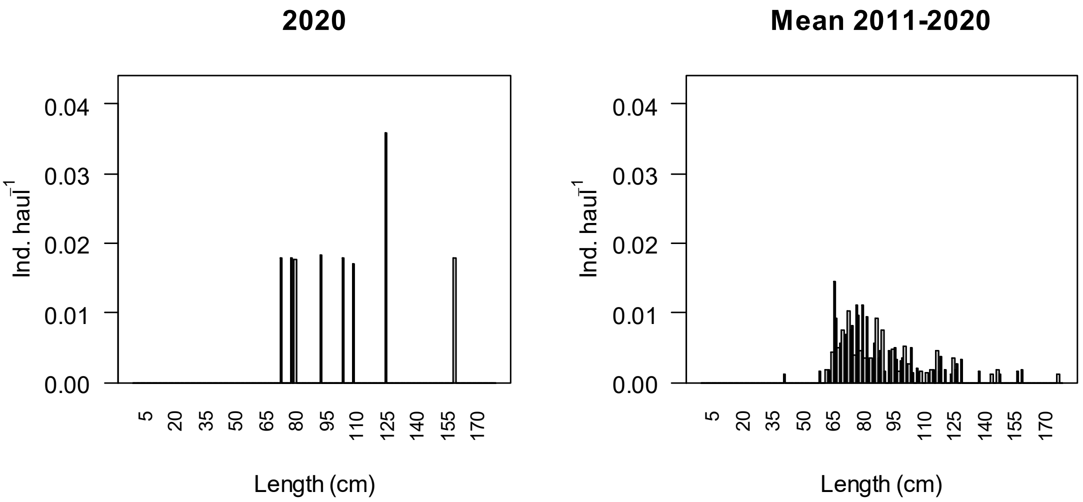

Figure 28. Stratified length distribution of *Hexanchus griseus* in the last Porcupine survey, and mean values in Porcupine surveys between 2011 and 2020.

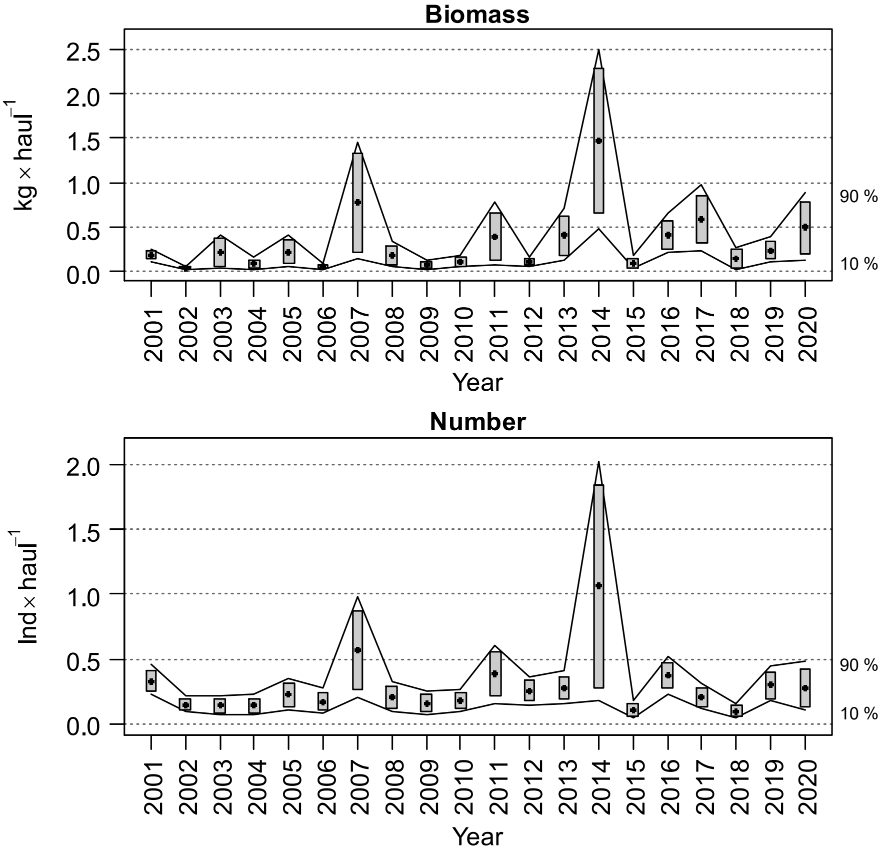

Figure 29. Evolution of *Dalatias licha* biomass and abundance indices in Porcupine surveys (2001-2020). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

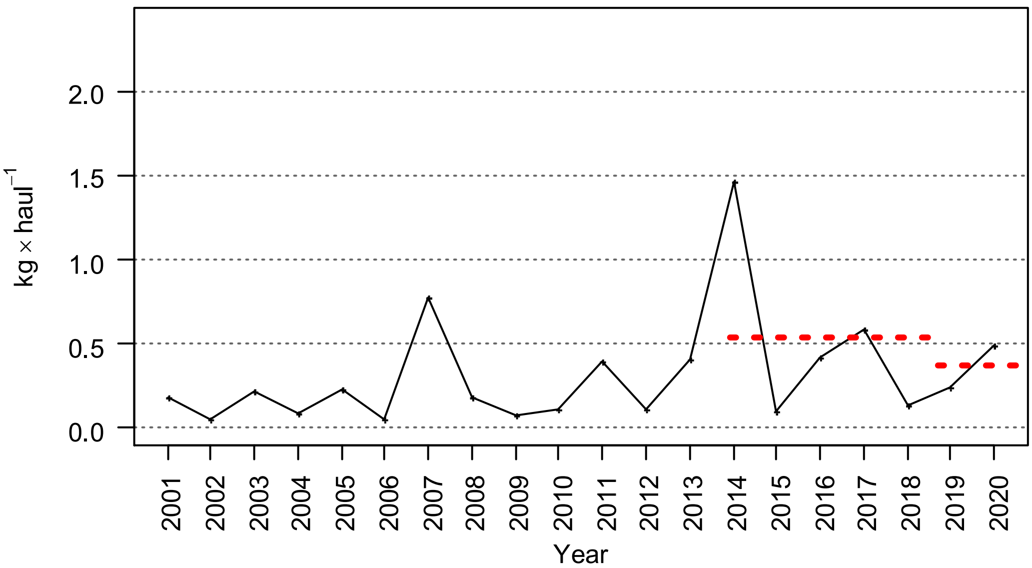

Figure 30. Evolution in *Dalatias licha* biomass index in Porcupine surveys (2001-2020). Dotted lines compare mean stratified biomass in the last two years with the five previous years

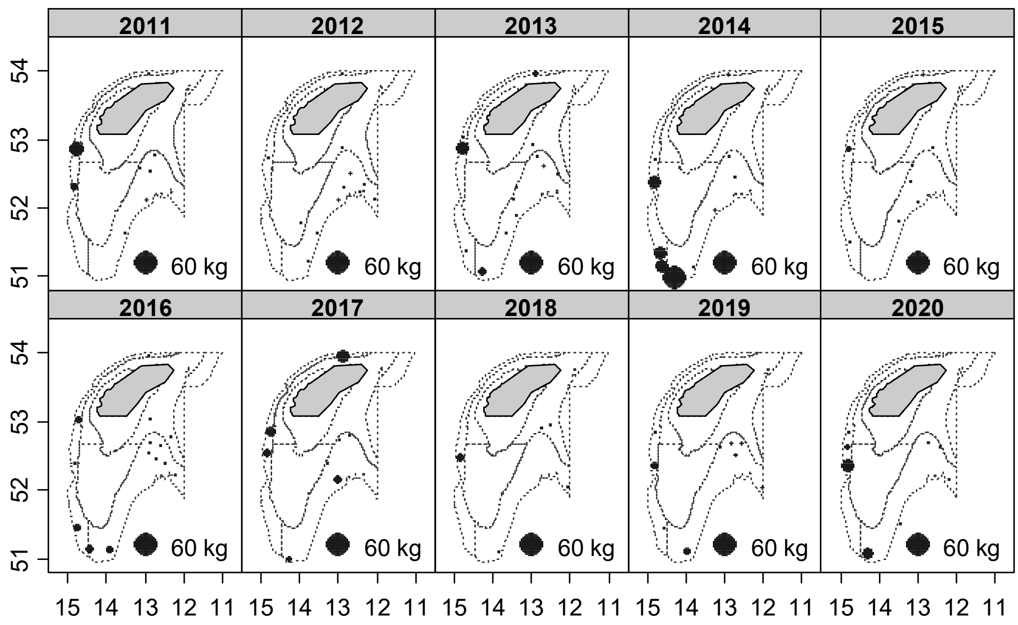

Figure 31. Geographic distribution of *Dalatias licha* catches (kg×30 min haul^{-1}) in Porcupine surveys (2011-2020)

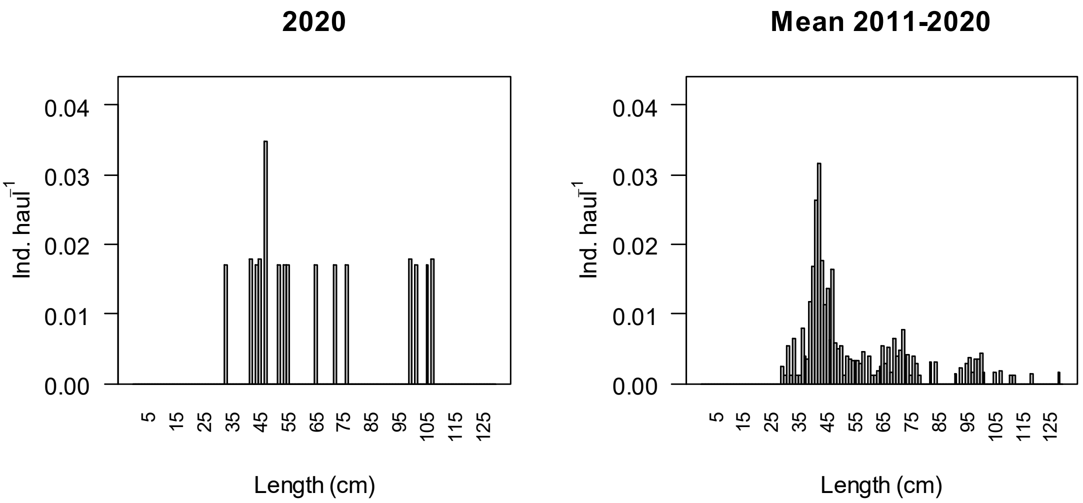

Figure 32.- Stratified length distribution of *Dalatias licha* in the last Porcupine survey, and mean values in Porcupine surveys between 2011 and 2020.

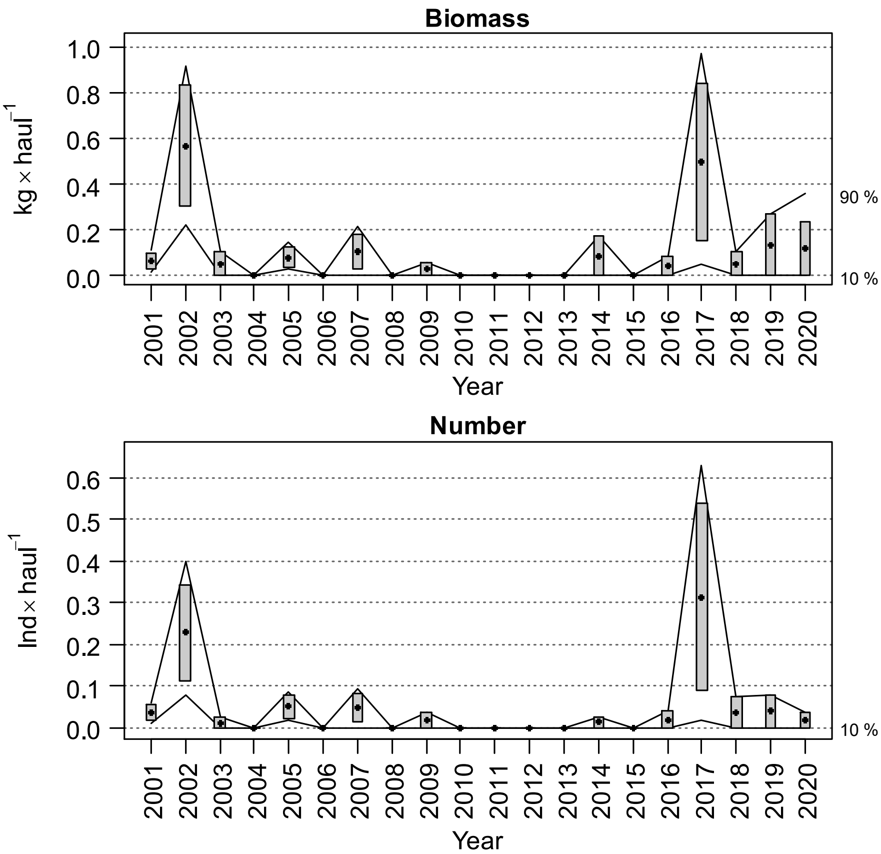

Figure 33. Evolution of *Squalus acanthias* biomass and abundance indices in Porcupine surveys (2001-2020). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

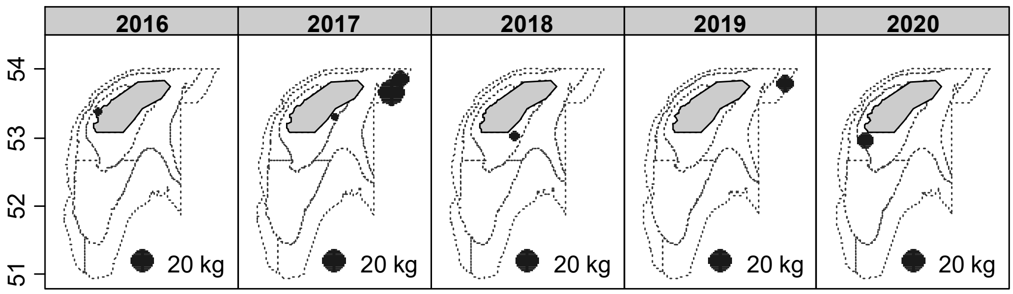

Figure 34. Geographic distribution of *Squalus acanthias* catches (Kg· $haul^{-1}$) in Porcupine surveys 2016-2020

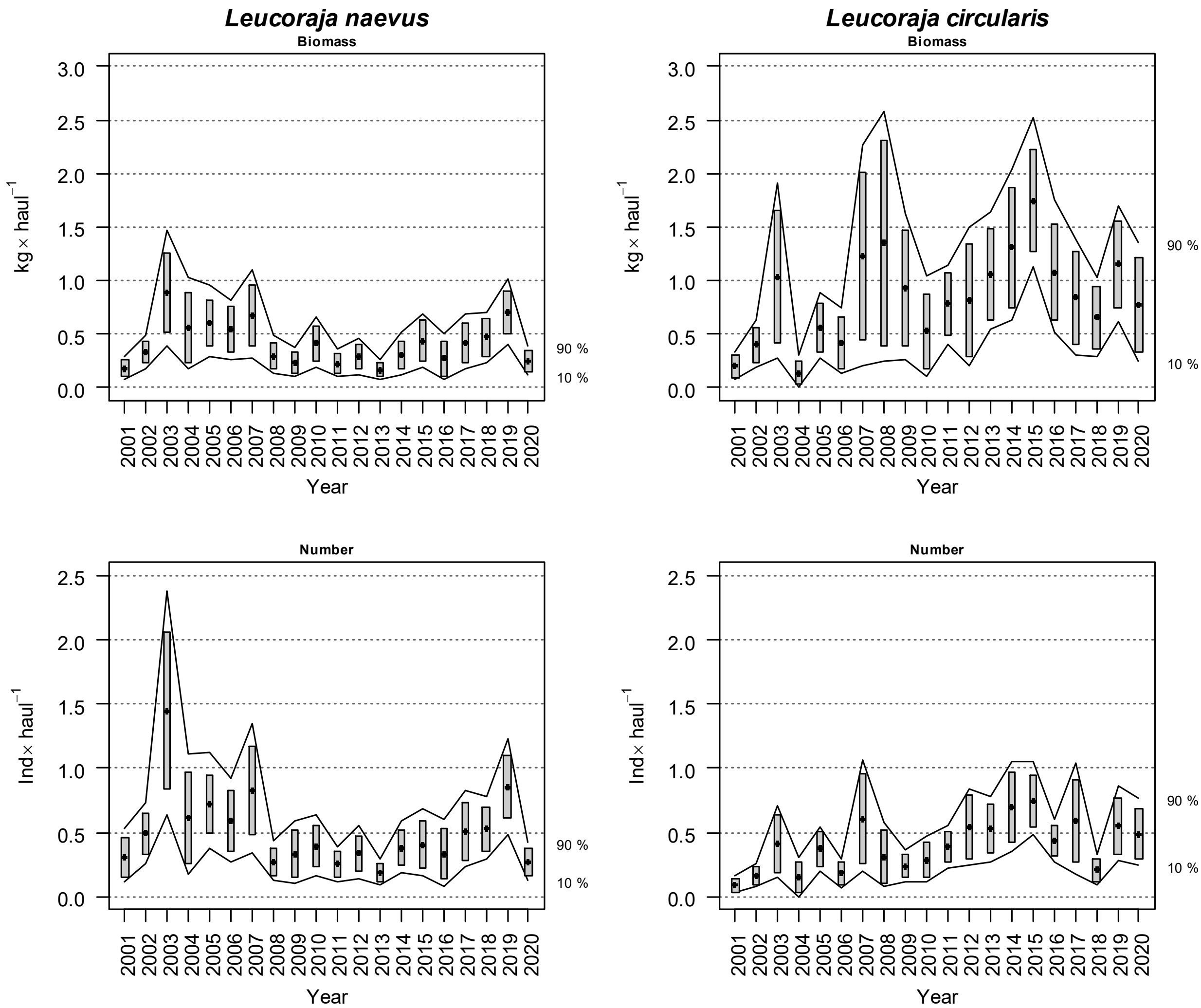

Figure 35. Changes in *Leucoraja naevus* and *Leucoraja circularis* biomass and abundance indices in Porcupine surveys (2001-2020). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations =1000)

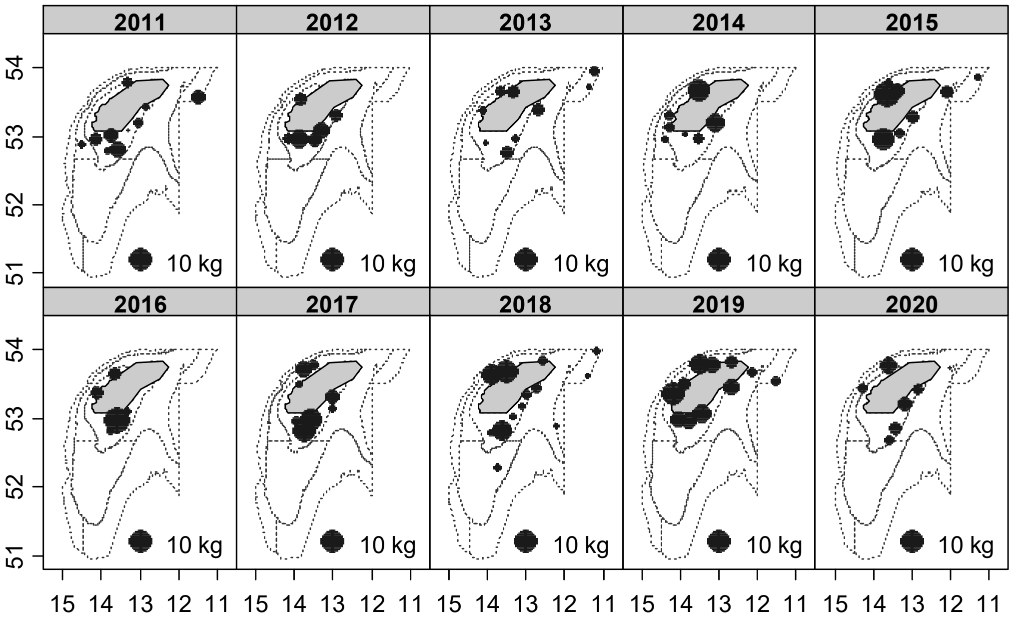

Figure 36. Geographic distribution of *Leucoraja naevus* catches (kg·haul^{-1}) in Porcupine surveys (2011-2020)

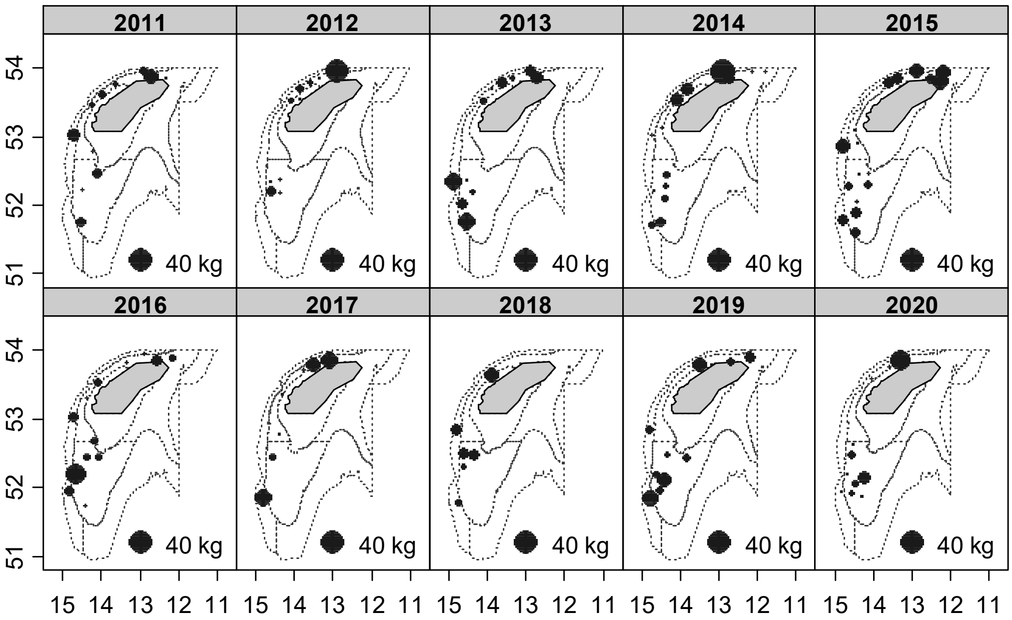

Figure 37. Geographic distribution of *Leucoraja circularis* catches (kg·haul^{-1}) in Porcupine surveys (2011-2020)

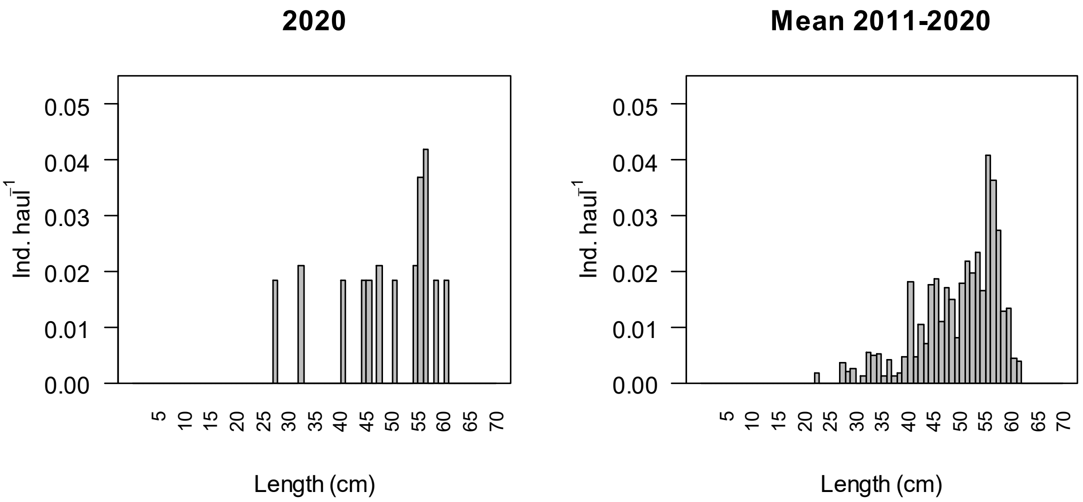

Figure 38. Stratified length distribution of *Leucoraja naevus* in the last Porcupine survey, and mean values in Porcupine surveys between 2011 and 2020

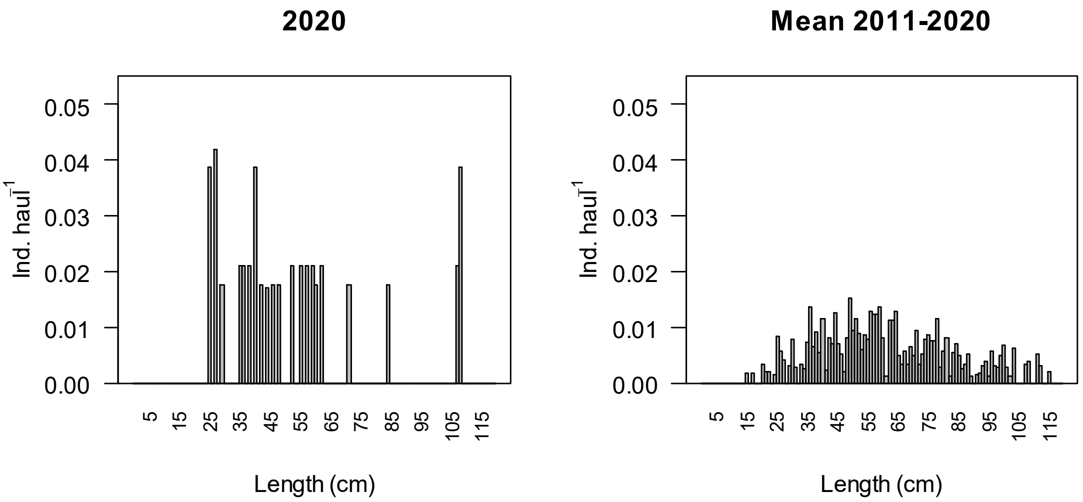

Figure 39. Stratified length distribution of *Leucoraja circularis* in the last Porcupine survey, and mean values in Porcupine surveys between 2011 and 2020

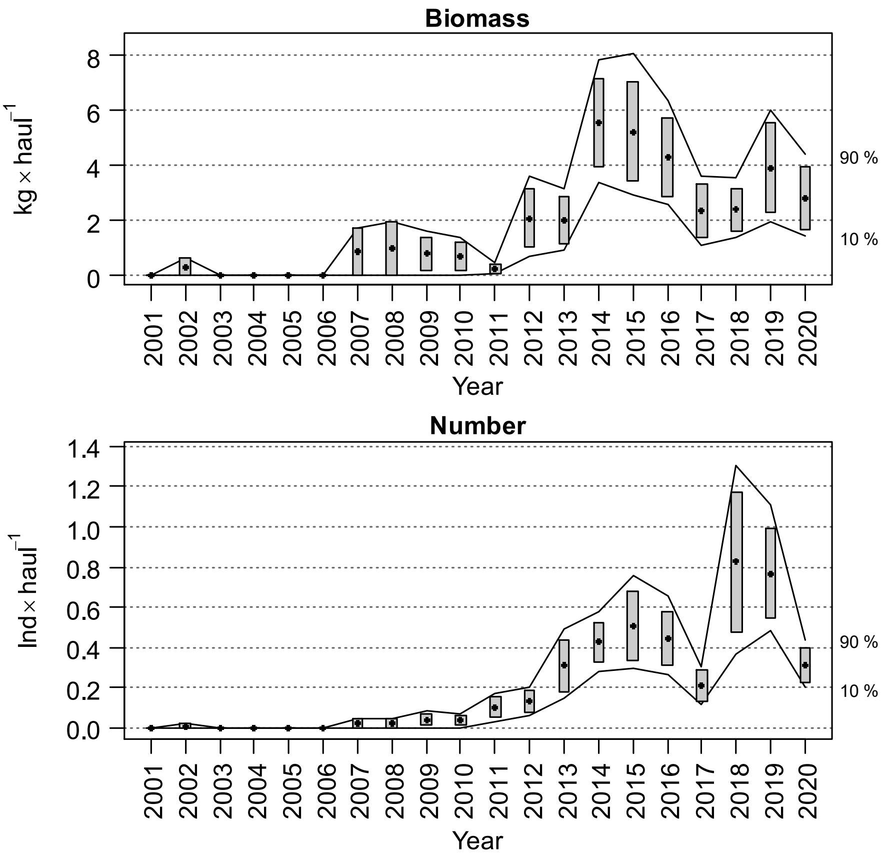

Figure 40. Evolution of *Dipturus* spp. biomass and abundance indices in Porcupine surveys (2001-2020). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

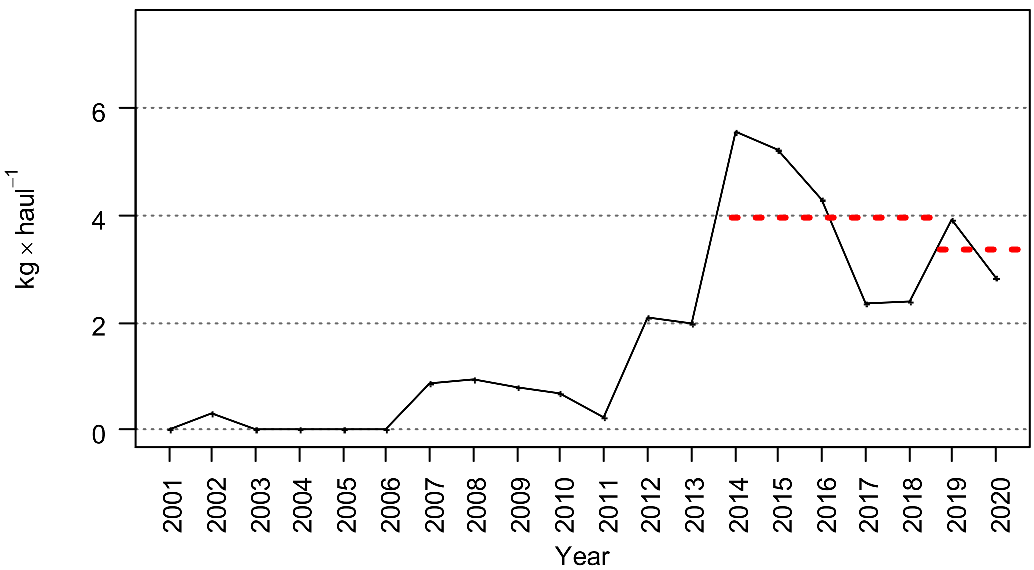

Figure 41. Evolution in *Dipturus* spp. biomass index in Porcupine surveys (2001-2020). Dotted lines compare mean stratified biomass in the last two years with the five previous years

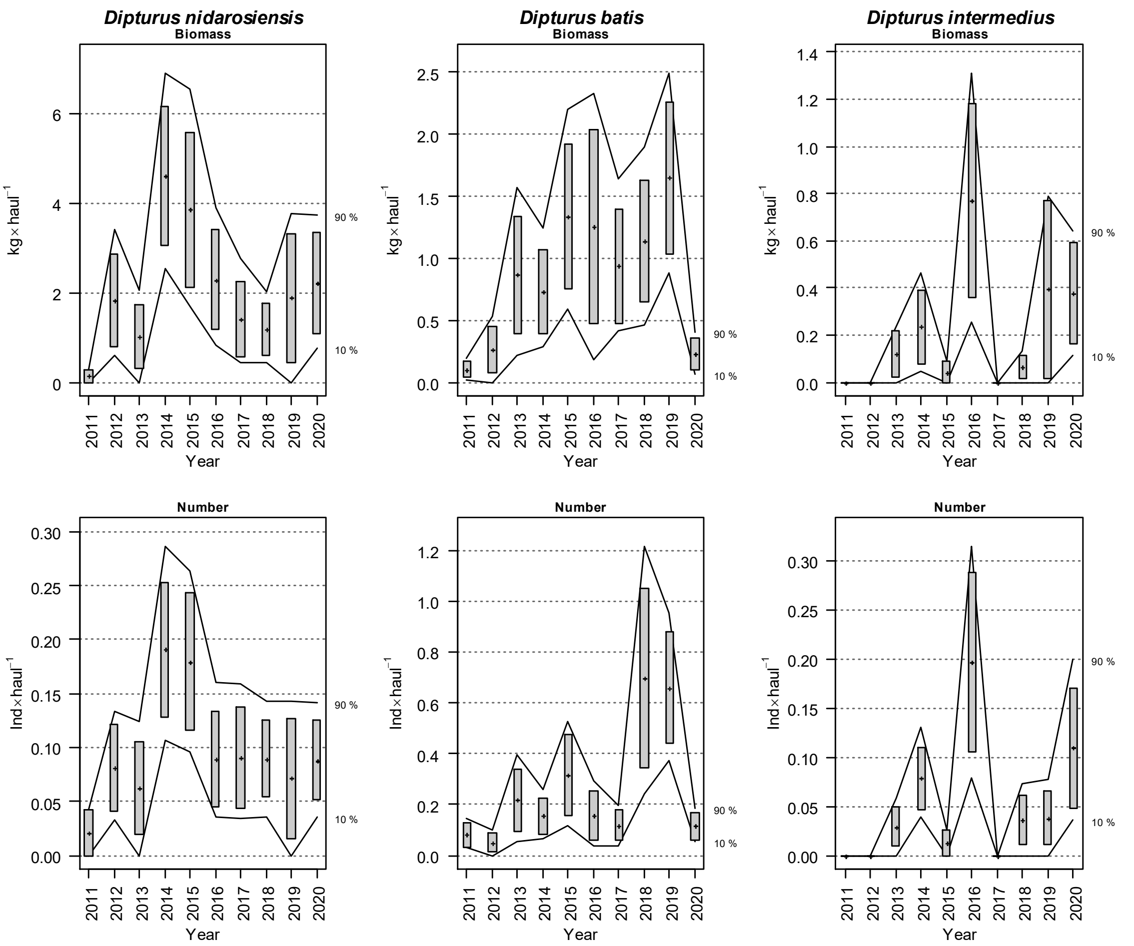

Figure 42. Evolution of *Dipturus nidarosiensis*, *Dipturus batis* and *Dipturus intermedius* biomass and abundance indices in Porcupine surveys (2011-2020). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000)

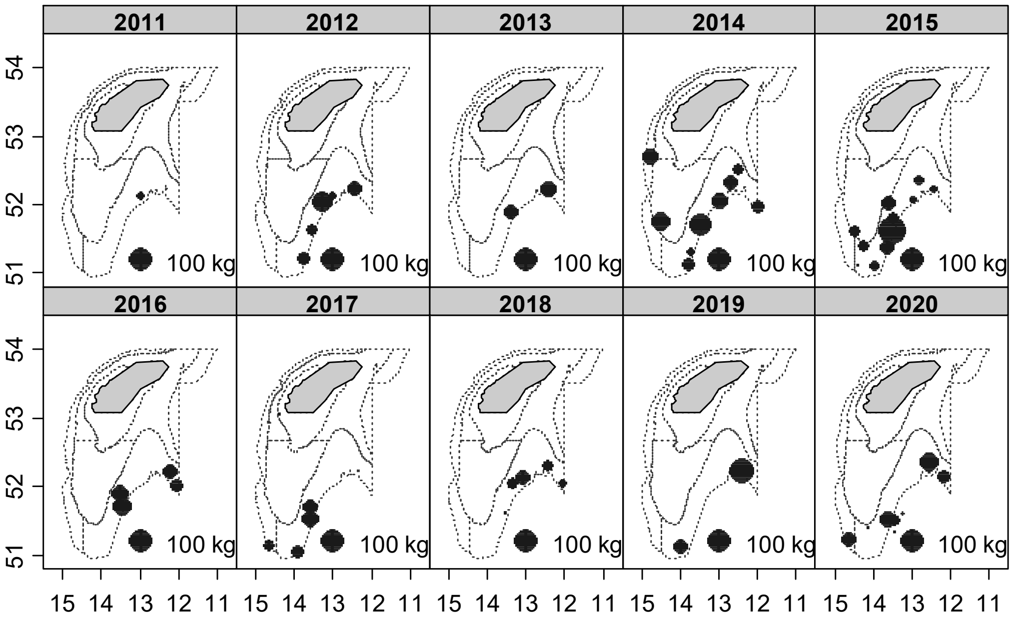

Figure 43. Geographic distribution of *Dipturus nidarosiensis* catches (Kg· haul^{-1}) in Porcupine surveys (2011-2020)

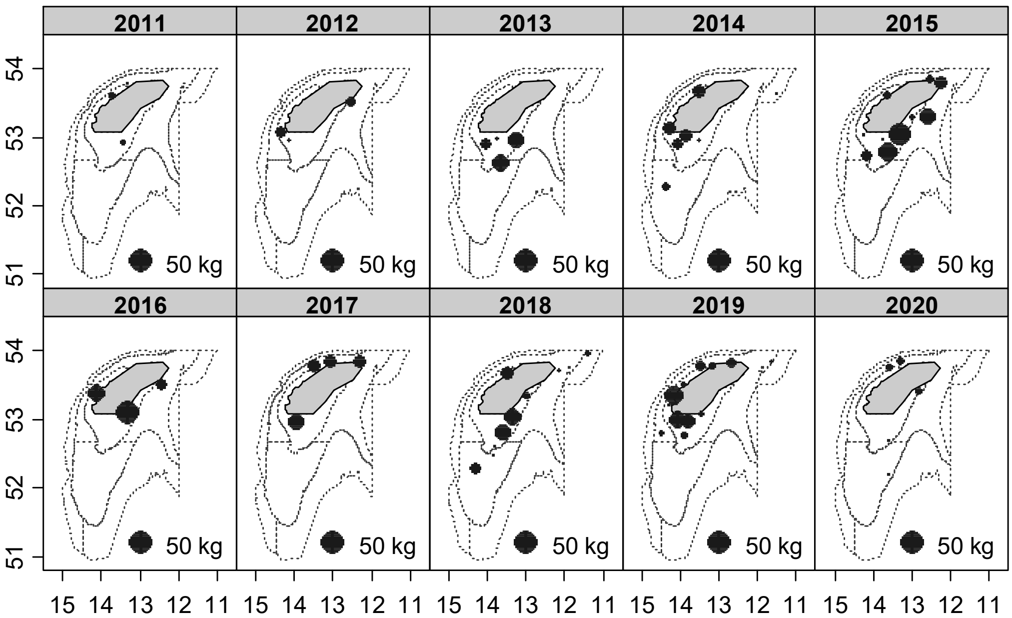

Figure 44. Geographic distribution of *Dipturus batis* catches (Kg· haul^{-1}) in Porcupine surveys (2011-2020)

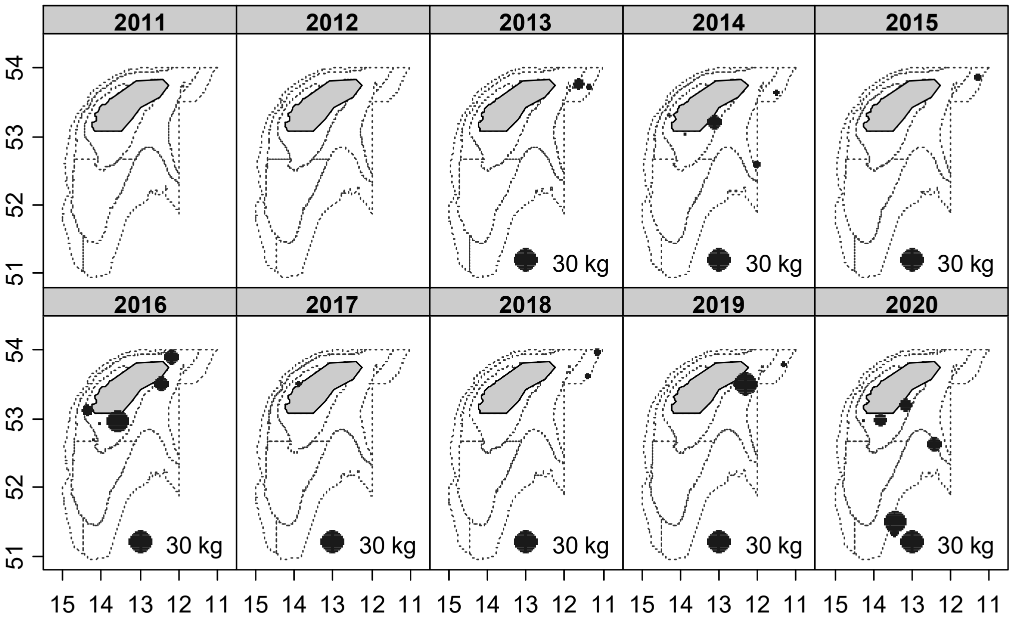

Figure 45. Geographic distribution of *Dipturus intermedius* catches (Kg· haul^{-1}) in Porcupine surveys (2011-2020)

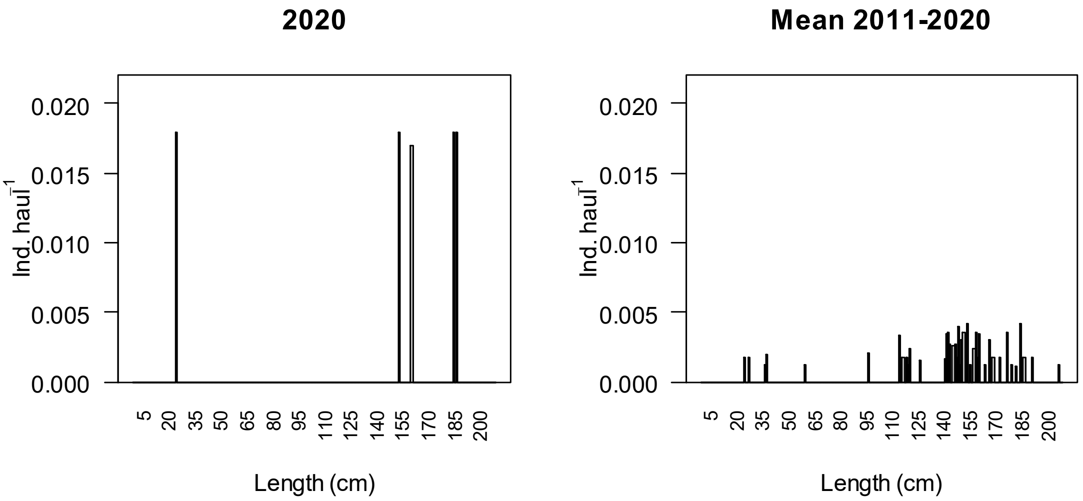

Figure 46. Stratified length distribution of *Dipturus nidarosiensis* in the last Porcupine survey, and mean values in Porcupine surveys between 2011 and 2020.

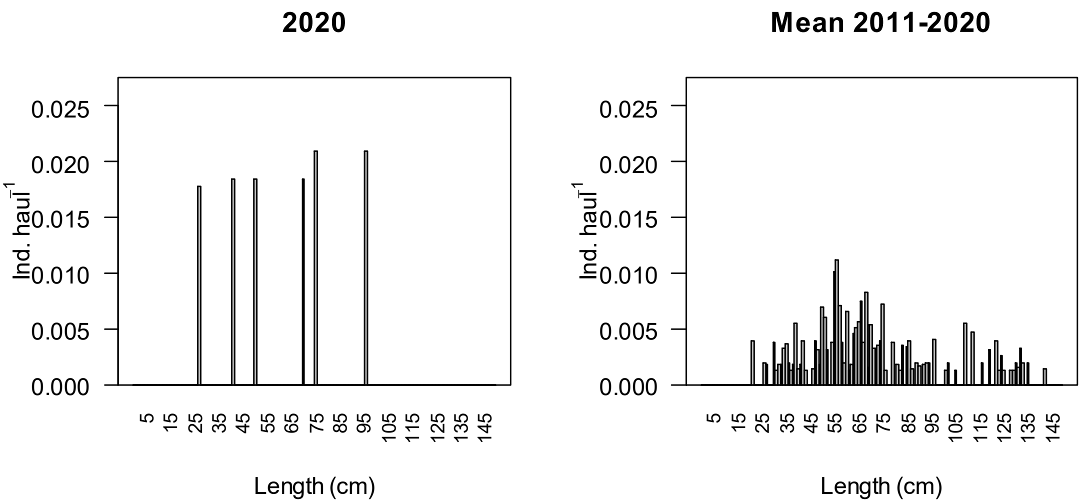

Figure 47. Stratified length distribution of *Dipturus batis* in the last Porcupine survey, and mean values in Porcupine surveys between 2011 and 2020.

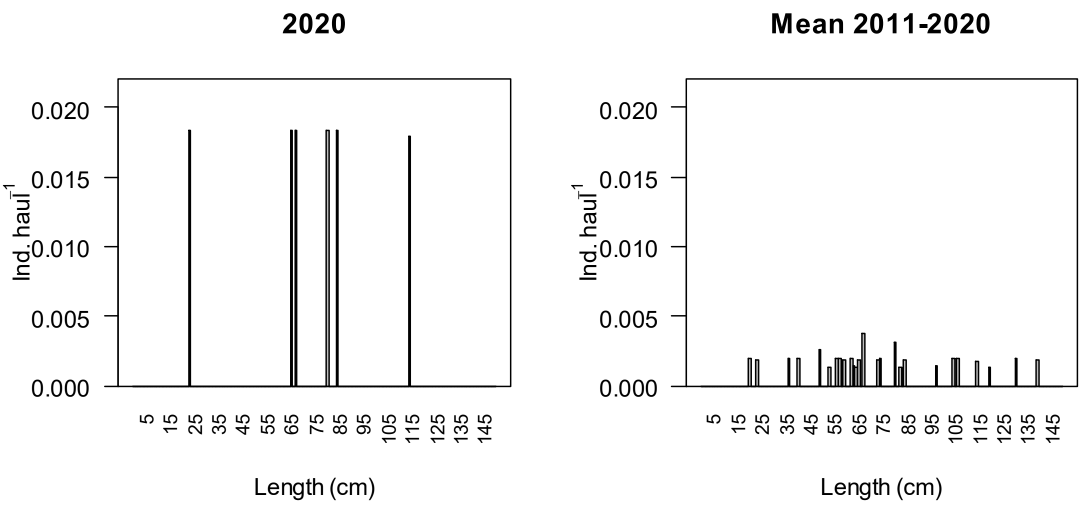

Figure 48. Stratified length distribution of *Dipturus intermedius* in the last Porcupine survey, and mean values in Porcupine surveys between 2011 and 2020.

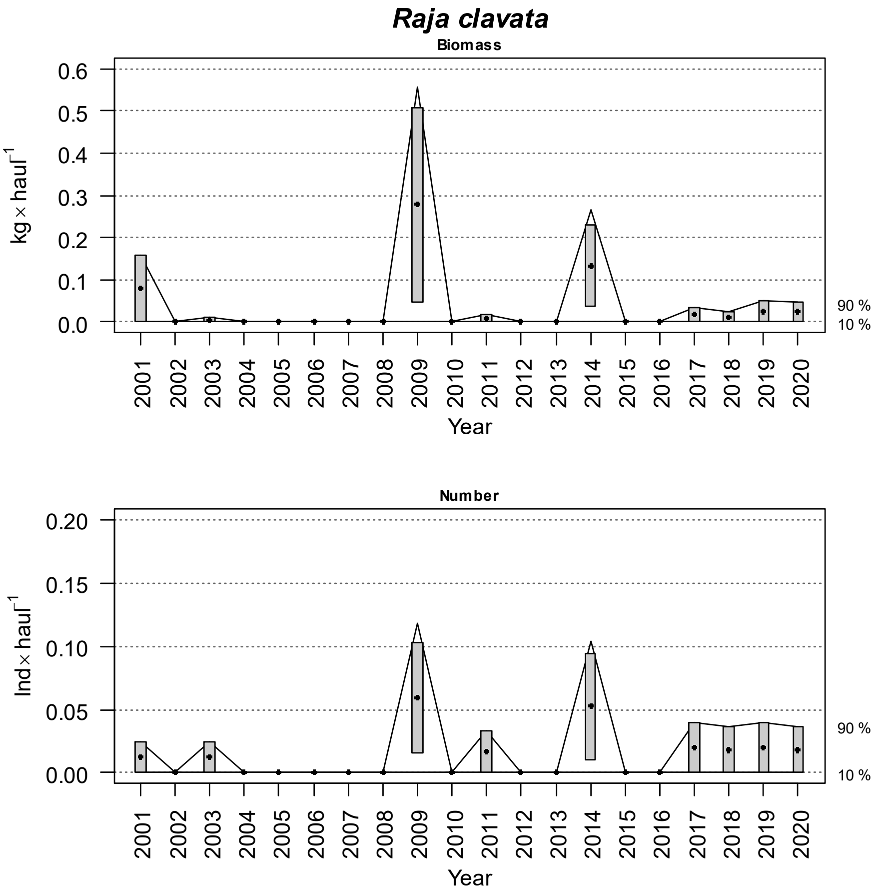

Figure 49. Evolution of *Raja clavata* biomass and abundance indices from 2001 and 2020 Porcupine surveys. Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations =1000)

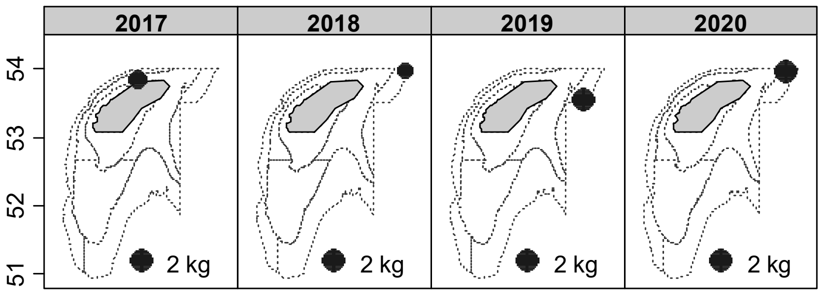

Figure 50. Geographic distribution of *Raja clavata* catches (Kg· haul^{-1}) in Porcupine surveys (2017-2020)